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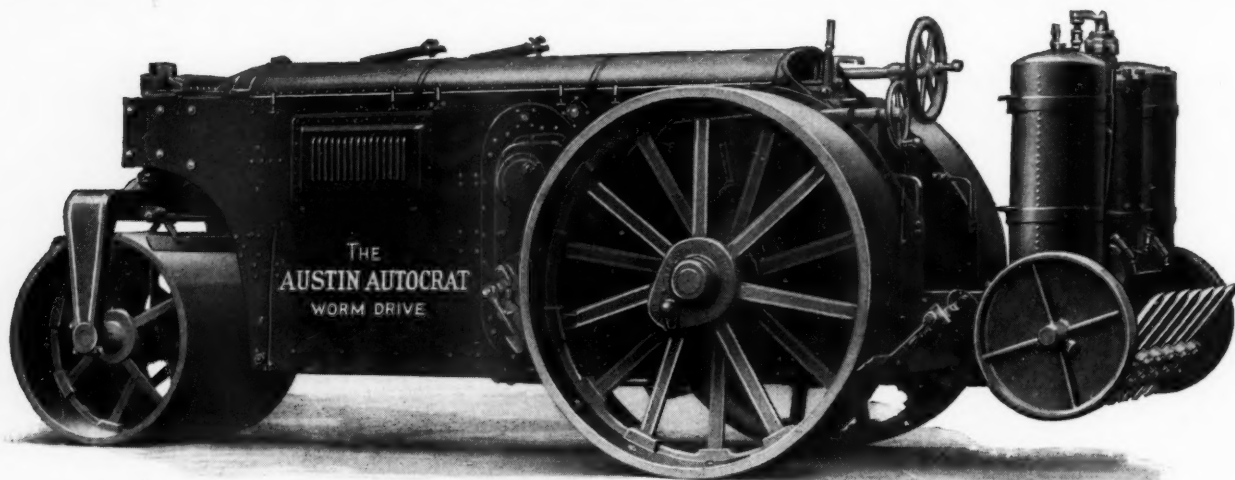
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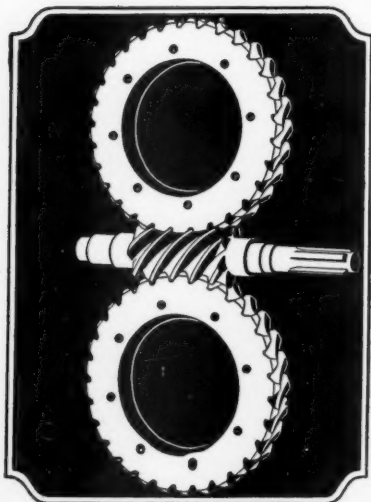


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Vol. 58

December, 1927

No. 12

Street Cleaning, Refuse Collection and Snow Removal in Newark

Methods employed in cleaning streets by men and machinery. Separate collection of refuse, with garbage fed to hogs and rubbish and ashes dumped. Snow removed from business district and all main thoroughfares

The congested and heavily traveled streets of Newark, N. J., offer many difficulties to those engaged in street cleaning and refuse collection, and these difficulties are enhanced by the character of the population and its density in various parts of the city. Snow removal is an especially important part of the work because Newark is the shopping center for a large surrounding area, from which many motor highways and trolley and bus lines lead into the city. The prompt removal of snow is therefore a necessary and, to the business establishments of the city, a financially important undertaking.

STREET CLEANING

In street cleaning, a combination of methods is used, including block men, district gangs, and motor flushing and sweeping. The choice of the particular method to be used on a given street depends upon the character of the pavement to be cleaned, the district, the type of cleaning necessary, and similar considerations. The block men, as a rule, are assigned main arterial streets; the gangs handle the

less important residential sections; the motor sweeper is also assigned to the residential sections; and the motor flushers work throughout the city.

Block Men—There are about 90 block men, all uniformed. Each is assigned a designated section, usually on the main through streets. The area and length of the section depends upon its location and importance, and the amount and character of the traffic passing over it. Brooms and shovels are used. The sweepings are deposited in covered metal boxes, which are placed in convenient locations along the curb lines. The distance between these boxes is usually 200 to 250 feet, but may be more where experience has shown it to be permissible. The use of these boxes prevents nuisance due to delays in picking up the sweepings and to the blowing or scattering about, which would be certain to occur if the sweepings were left in the gutter. Their use also eliminates the necessity of having a close follow-up of dirt collection wagons, since the boxes, which have a capacity of about 7 cubic feet, may retain the



FIG. 1—REMOVING SNOW FROM ONE OF NEWARK'S MAIN BUSINESS STREETS



FIG. 2—BLOCK MAN AND STREET DIRT BOX

sweepings for two or three days. Normally, however, the boxes are cleaned daily in the more important areas. This service is performed by the trucks following the district cleaning gang, and also by the refuse collection trucks.

Street dirt boxes are constructed of sheet metal, with a frame of iron bars. They are made sturdy and heavy, not only to insure long life, but also to prevent emptying by dumping, which, due to throwing on and off the trucks would result in quick deterioration. Boxes are required to be emptied by shovels. These boxes are 18 inches wide, 18 inches deep and 38 inches long, and have a close-fitting hinged metal cover. Handles on either end make handling easy.

Street sweepings, since the advent of the automobile, are composed mainly of street litter and other inorganic components, and do not contain enough putrescible material to cause complaint, even if they should be left in the box for several days, which is rarely the case.

District Gangs—Supplementing the block men are the district gangs. There are 17 of these, each assigned to a street cleaning district and operating under the direction of a district foreman, who also has supervision over the block men in his district. The gangs total about 125 men, and are responsible for all hand cleaning in their respective districts. They work on a prearranged schedule designed to provide cleaning service over each entire district at regular intervals. The sweepings are left in the gutter to be picked up by a truck which follows

them rather closely. In congested sections, streets are cleaned daily, while in residential sections cleanings are less frequent; but all streets are cleaned at least once a week.

Street sweepings are disposed of at various dumps; usually they are hauled to the regular refuse dumps, but sometimes temporary dumps are available which may reduce materially the length of haul.

Motor Flushing and Sweeping—The city owns 7 single-unit flushers, each with a 1,500-gallon tank mounted on a Mack 5-ton chassis and one Elgin motor sweeper. The latter machine works daytime, mainly in the residential part of the city, and averages about 90,000 square yards per day. The flushers work throughout the city, on a regular schedule so arranged that most of the streets are flushed two or three times a week. Each machine averages 100,000 to 150,000 square yards per 8-hour day. Four of the flushers are also used regularly on night flushing work in the congested business streets which cannot be cleaned in the daytime because of traffic. In hot weather flushers are used in the early evening in the thickly populated sections to clean and cool off the streets, a service which is much appreciated by the people living in these districts.

Sanding Streets—This is an important function during the winter months. Sand boxes are placed at strategic points, and 2½-ton Mack trucks, equipped with sand spreaders, are operated regularly when needed over those areas which, from experience, have been found to provide conditions dangerous to traffic.

The expenditures for street cleaning during 1926 amounted to \$441,691.94, which amount includes salaries, wages and other costs, not including snow removal.

REFUSE COLLECTION AND DISPOSAL

Refuse is separated by the householders into two classes, garbage and rubbish, the latter term including ashes and paper. During 1926, there were collected 818,617 cubic yards of rubbish, and 15,548 tons of garbage. The cost of the service during 1926 amounted to \$1,104,815.52.

Collection—In the business sections, there are three collections weekly of both garbage and rubbish throughout the year. In strictly residential sections, separate collection is maintained, and there is one collection of rubbish and three of garbage in the summer, and two collections of each in the win-



FIG. 3—RUBBISH COLLECTION WITH OLD-STYLE BODY ON MACK 5-TON CHASSIS

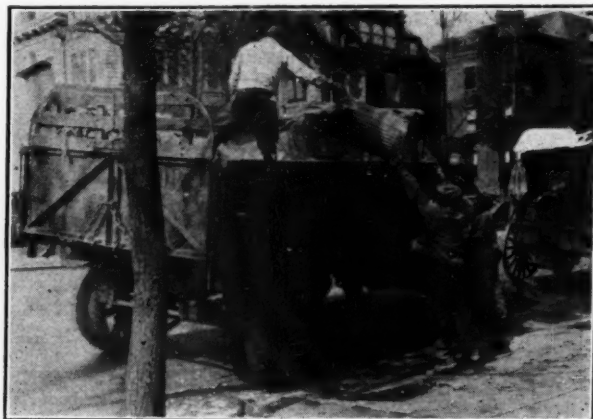


FIG. 4—LOADING RUBBISH COLLECTION TRUCK

ter. While separation is generally enforced, in certain much congested residential sections where conditions make separation difficult there is mixed collection three times a week throughout the year. Collection is actually from the back door, but the collection vehicles are preceded by a special detail of men who remove the containers from the back door, or other places, to the curb, where they can be emptied into the wagons without delay. The empty cans are not generally replaced at the back door, but are usually set inside the sidewalk line, or close to the building. Normally 3 or 4 men accompany the collection vehicles.

Rubbish containers are required to be tight and metal is preferred, but substantial wooden boxes or baskets are permitted. For garbage, a tight, covered metal can is required.

Collection Vehicles—Both horse-drawn and motor-driven refuse collection vehicles are used. On garbage collections, there are two Mack motor trucks with 5-yard tight metal bodies, and twenty-four horse-drawn carts and wagons. The motor vehicles are used mainly in the sections requiring the longest haul, and especially where it is possible to secure a full load with the minimum number of stops. The horse-drawn units are mainly of the cart type, with tight, rear-dumping, metal bodies, holding about 3 cubic yards. In some cases, bottom-dump wagons are used, but these are not considered entirely satisfactory for the work.

On rubbish collection, also, both horse and motor vehicles are used. The standard 2-horse truck has a capacity to the ridge pole of 7 cubic yards. There are two types of motor vehicle bodies, both mounted on Mack 5-ton chassis. The new type, shown in Fig. 6, differs mainly from the old, shown in Fig. 5, in side height, and in the loading door in the side, which makes the labor of loading much less difficult. In each body the capacity is about 17 cubic yards.

All collection vehicles are provided with canvas covers which are tied firmly in place after loading has been completed. The use of the covers, which is strictly enforced, minimizes complaints due to spillage and to the blowing about of paper and ashes while in transit to the dump.

Disposal—The garbage, excepting the comparatively small amount collected as mixed refuse from the thickly populated sections of the city, is hauled to a privately owned and operated piggery located on the edge of the salt meadows but within the city limits. About 3,500 pigs are maintained at this plant, which is said to produce a small profit. The city receives no pay for the garbage, which is delivered free at the piggery, but it is stated that this



FIG. 5—HORSE-DRAWN RUBBISH WAGON



FIG. 7—MOTOR FLUSHER ON A MAIN BUSINESS STREET

method of disposal is cheaper than any other would be, since the haul is comparatively short.

A small part of the ashes and rubbish is used for street and other filling in the city, but most of it is taken to the main refuse dump in the salt meadows south of the city. In connection with this dump, a fill is now being made for a projected state highway which will pass nearby. One or two smaller dumps are used, but the amount of material hauled to them is comparatively unimportant.

The dump, which is composed almost entirely of non-putrescible material, is practically unobjectionable. A foreman is in charge of the dump, and he, with his assistants, constructs and maintains the roads necessary for the passage of the refuse vehicles, regulates dumping and has charge of the picking-over privileges. Roads are constructed from selected waste material, such as street and cellar excavation and ashes. These are maintained as near as possible to the dumping edge, the dumped material being scattered and placed by means of caterpillar tractors equipped with La Plante-Choate "Bulldozers" and other types of scrapers.

SNOW REMOVAL

A complete organization is provided for promptly clearing streets of snow. Available city equipment and personnel are supplemented by those provided by contractors, with whom, by prearrangement, complete schedules for snow fighting are provided. There were 307 miles of paved streets, as of January 1, 1927, and the program calls for the clearing of these after every snow-fall as quickly as possible. In the winter of 1925-26, \$280,000 was spent on snow removal.

The central section of the city is handled by city forces. The remaining area is divided into 12 contract removal districts. The work of clearing these is assigned to contractors, who are required to fur-



FIG. 6—NEW STEEL BODY RUBBISH TRUCK
The side door greatly reduces height of lift of rubbish until truck is half full. End doors hinged at the sides, opened for dumping



FIG. 8—CATERPILLAR WITH BULLDOZER LEVELING GARBAGE DUMP

nish for the work, a designated number of men and pieces of equipment. Upon notice, these contractors must start at a designated point and work over certain streets. Proper inspection and time-keeping service is maintained by the city, which fixes the price to be paid for labor, foremen and supervision. Equipment is rented or paid for on the basis of work done. Labor rates are uniform for all contractors, who are allowed 15 per cent. to cover profit and overhead.

All paved streets are plowed after every snowfall, and snow is removed from a great part of the center of the city and from all important arterial streets. By arrangement with the Public Service Corporation, which operates the street car lines in Newark, a cooperative scheme has been adopted, whereby on certain streets having car lines, the company clears the streets from curb to curb, while on other streets the city does the work. This eliminates overlapping of work, and produces more satisfactory results.

The snow is piled by plows, and then loaded into trucks for disposal. Loading machines are used on this work, and the city owns seven Barber-Greene and one Nelson loaders. The snow handled by trucks is dumped into the Passaic River from two city docks. Snow is also pushed into manholes of the storm sewer system by means of a Fordson tractor and a Riddell grader.

In snow fighting, 40 contract trucks, for which city-owned plows are provided, are used to supplement the city equipment, which consists of one Elgin auto-eductor, twenty-four 5-ton Mack trucks, four 2½-ton Mack trucks, ten 10-ton caterpillar tractors,

and one Fordson tractor. The snow plows used on the contract trucks are stored at the contractor's plants so as to be available immediately in case of need.

During periods of snow removal activity, the trucks normally engaged in refuse collection are used for snow fighting, but scavenging work is not discontinued, trucks being hired to replace those temporarily engaged in snow work.

OTHER ACTIVITIES

About 140 horses are employed, most of them on street cleaning work, but a number also on refuse collection. These horses are maintained in two stables, in conjunction with which is operated a repair and blacksmith shop, where horses are shod, and all wagons, street dirt containers, and waste paper receptacles are repaired and painted. Some work is done for other departments of the city also. A horse isolation hospital is operated, where sick horses are maintained out of contact with other horses. This, it is said, has been an important factor in reducing the time losses from sick animals, especially during the seasons when colds and influenza are prevalent among the horses.

A large and modern garage and repair shop has recently been completed for the storage and maintenance of heavy motor vehicles. This building, which was designed by, and constructed under the supervision of the Bureau of Street Cleaning, provides storage space for all active and reserve equipment, and furnishes facilities for making all ordinary repairs.

James W. Costello is chief engineer of the Department of Public Affairs, of which Thos. L. Raymond, Mayor, is director. Goline Doremus is supervising engineer of the Bureau of Street Cleaning of this Department. Other officers and employees include Valentine Herman, Superintendent of the Bureau of Street Cleaning; Edward A. Bechler, Assistant Superintendent of Street Cleaning; Robert Struble and Thomas McHale, Assistant Superintendents of Refuse Collection; Thomas Donovan, Assistant Superintendent in charge of motor equipment; Jules G. Rath, superintendent of stables; and Dr. James T. Glennan, veterinarian.

Dust Prevention in Missouri

In an effort to control an exceedingly dusty gravel road located on a sandy ridge, the Missouri State Highway Department tried out two methods of dust prevention. One was the spreading, in two succes-



FIG. 9—SHOVING SNOW TOWARD SIDE OF A NEWARK STREET



FIG. 10—STORAGE ROOM AND OFFICE AT HUDSON ST.

sive treatments, of approximately two pounds of calcium chloride per square yard. The other consisted of surface treatment, using a special slow-hardening asphalt road oil. Both methods were successful. The calcium chloride took up moisture from the air and kept the gravel surface damp. The results were good in laying the dust and preserving the surface, but the treatment must be repeated each year. This treatment cost 3.6 cents per square yard, or about \$383 per mile. The light asphalt oil treatment cost 12 cents a square yard, or \$1,268 per mile. This is of a semi-permanent nature, yielding a hard, durable surface, which will probably need a further light treatment the following year, after which maintenance costs will average about \$500 per mile.

Holding a Sliding Hill

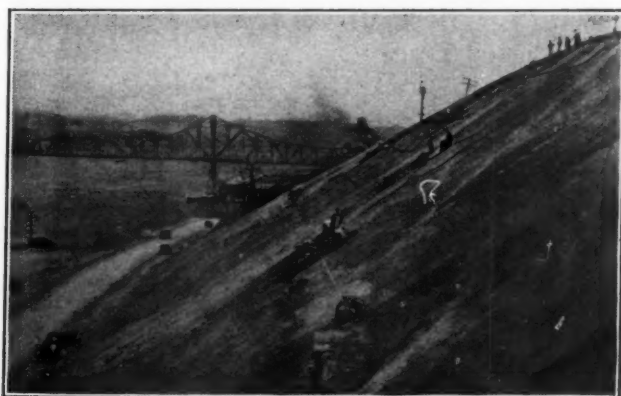
A short distance west of Crockett, Calif., at the south approach to the Carquinez highway bridge, is a sliding hill known as the Valona slide which for years has been a source of trouble and at one time literally shoved the concrete pavement of the highway over a cliff, where it fell at least a hundred feet onto the tracks of the Southern Pacific railroad, which skirts the base of the hill. The formation here appears to have no solid foundation and when well saturated with water during the winter, moves in a solid mass.

The State Highway Department believes it has conquered the slide, describing the work as follows:

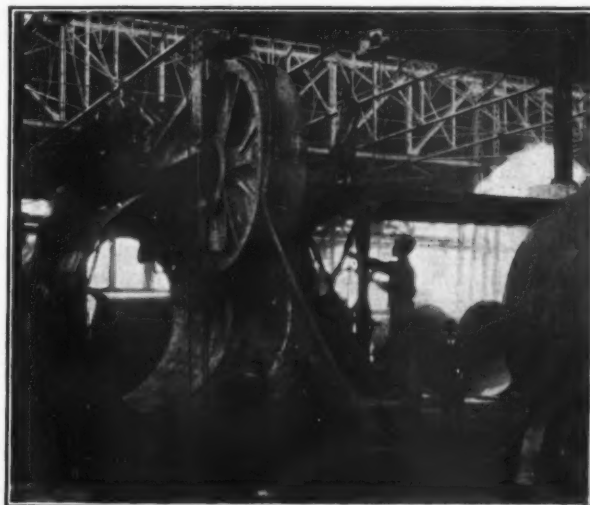
"The sliding hill has been given a 2-to-1 slope, and after being smoothed by hand work was paved with 2 to 2¼ inches of gunite.

"Gunite is a very fine mix of sand, cement and water, laid under air pressure by a cement gun. The sand and cement are mixed under pressure and led to the job through a hose under pressure. Just before it leaves the nozzle to be shot onto the job, the dry mix receives the water, properly proportioned. Eight sacks of cement were used to the cubic yard.

"Before placing the gunite, tile drains were installed. The pavement was placed in rectangular slabs, separated with premoulded bituminous composition strips, one-half inch thick. The slabs were reinforced with wire fabric, No. 8 gauge, spaced 4 inches apart. The reinforcing was held in place by means of concrete or metal chains. Each slab



CONCRETING THE VALONA SLIDE
Over an acre of concrete was placed on this hill. The new \$8,000,000 Carquinez highway toll bridge in the background



RIVETING PIPE IN THE WORKS NEAR SAO PAULO

was attached to the subgrade with four cement concrete anchors, 6 inches in diameter and 2 feet 6 inches long, reinforced with deformed bars. To cure the slope, it was covered with burlap and uniformly sprinkled with a fine mist for four days.

"The whole slope contains 44,560 square feet, or slightly more than an acre of concrete. A. Tiechert & Son had the contract."

The Sao Paulo Aqueduct

Forty-eight miles of gravity conduit and steel pressure conduit brings filtered water from reservoirs in the mountains. During dry season pumping from a lower reservoir will be necessary.

There is now under construction in Brazil an aqueduct about 48 miles long to bring water to the city of Sao Paulo from the Rio Claro basin. About 5 miles of this, which will be under pressure, will be of pipe 2½ meters (98 inches) in diameter; 15 miles will be pressure pipe 1.8 meters (71 inches) in diameter; while the remainder of the aqueduct is



TRANSPORTING PIPE TO LOCATION ON TRAILERS

of reinforced concrete. There are about 50 tunnels on the line of the aqueduct, the combined length of which is 14,600 meters, the longest being nearly $1\frac{1}{2}$ kilometers (0.9 mile). This aqueduct is to supply 200,000,000 liters (a little under 53,000,000 gallons) per day, being 250 liters for each of the 800,000 inhabitants.

The Rio Claro rises in Serro do Mar, a mountainous region very sparsely settled and covered with dense vegetation. Its drainage basin above the site of the dam contains about 160 square kilometers (61.8 square miles). Although there is little probability of pollution, it is proposed to insure the good quality of the water by filtering it in rapid-sand filters before it enters the aqueduct.

There will be a large reservoir with a dam at Casa Grande, while a smaller one will be built up the river at Poco Preto. From the basin above the latter will be drawn about 68,650,000 gallons per day during the rainy season, the balance passing down into storage behind the dam at Casa Grande. The amount mentioned will flow by gravity to the city for consumption. In the dry season the river discharge falls below the 68,000,000 gallons and the deficit will be taken from the large storage basin at Casa Grande, from which it will have to be elevated about 46 feet to the filters, this being done by compressed air. From the filters the water will pass by gravity to the city. The total runoff of the Rio Claro is calculated at the average of 68,864,000 gallons per day, being greatly in excess of this during the wet season and falling far short of it in the dry. It is calculated that about 23 per cent of the entire annual consumption will have to be elevated from the Casa Grande reservoir to the filters.

As stated, the pipe will be of two diameters, 1.8 meters and 2.5 meters, according to the length and pressure. It is calculated that the lost head in the reinforced concrete aqueduct will be $1\frac{1}{3}$ feet per mile, and that in the 1.8-meter pipe will be $3\frac{1}{4}$ feet per mile and that in the 2.5-meter pipe 2.1 feet per mile. The 2.5-meter pipe will be built of steel plates $\frac{1}{2}$ -inch thick and will be subject to a maximum pressure of 57 pounds per square inch. The 1.8-meter pipe will be built of $\frac{7}{16}$ -inch plates and subject to a pressure of 114 pounds per square inch. All of these will be constructed of Armco ingot iron plate. The contractor for this work, Braithwaite & Company of London, England, has built a factory near Sao Paulo to manufacture the pipe from plates received from England. Here the plates are rolled

and riveted together, three or more lengths being hydraulically riveted together to form long lengths to reduce the number of field-made joints, and the joints are pneumatically calked and the pipe given a coat of "Bowranite" bituminous paint, both internally and externally. The long lengths are then trucked to the location, where they are joined in the trench, riveted and calked in position.

All of the tunnels which are to be subjected to internal pressure will be lined with Braithwaite tunnel lining, which is constructed from Armco ingot iron plates $\frac{3}{8}$ -inch thick, 2 feet long, 16 to a complete circle, hydraulically pressed to form a series of internally flanged segments, which can be bolted together as the tunnel advances and form a continuous internal lining 2.6 meters in diameter, which will be lined with concrete. All curves are laid out with a uniform radius of 328 feet (100 meters), so that the same forms can be used for all. The forms, which are supplied by the Blaw-Knox Company, are made in 14 ft. 9 in. lengths and are telescopic.

As the territory in which the reservoirs and aqueduct were built is comparatively uninhabited, it was necessary to provide means of communication, and about 93 miles of roads were built in this connection.

The $26\frac{1}{2}$ miles of reinforced concrete aqueduct was designed by the New Works Commission, under which the new water supply is being designed and constructed, and is being built by three well-known Brazilian contracting firms.

Three reservoirs are being built in Sao Paulo, the largest with a capacity of 19,000,000 gallons and each of the others with a capacity of 6,467,000 gallons.

Poco Preto has an elevation of 2,772 feet above sea level. The elevation of water in the storage reservoir is 2,690 when full and 2,641 when empty. The elevation of the discharge of water in Sao Paulo is 2,608.

Plans for the aqueduct were begun about 1918 but final orders for material were not placed until the summer of 1926. The chief engineer of the New Works Commission is Dr. Henrique Novaes, a graduate of the Rio Polytechnical School of Civil Engineering.



SECTIONS OF PIPE IN TRENCH READY FOR JOINING



PIPE SECTIONS ARE LINED UP IN THE TRENCH WITH THE TRAVELLER, BOLTED, AND RIVETED

Refuse Disposal in England

Summaries of figures for seventy-nine municipalities, giving quantities of refuse and cost of collection and of disposal per capita and per ton. Street cleaning costs.

In 1925, the Minister of Health of England asked the councils of county boroughs to furnish returns on the cost of public cleansing for the fiscal year 1925-1926. Returns were received from 79 towns and these are summarized in the annual report of the Ministry of Health for the fiscal year 1925-26. The minister states clearly that it is not suggested that towns can be compared simply on these figures. To make a comparison, account would have to be taken of local conditions, which differ greatly in the different towns. Proper cost accounts are, however, essential for economy of service.

This being the first time such accounts had been asked for, it was natural that there should be some shortcomings in them and these are listed by the minister as follows:

1. Failure of some councils to keep separate accounts for collection and for disposal.
2. Failure to record weight of refuse. Instances have come to the notice of the department in which statistics of cost had been wholly misleading because of the absence of any proper record or estimate of the weight of the refuse.
3. Cost of dumping has been included by some towns in that of collection, but should be included in the cost of disposal.
4. Different numbers of days in the year have been used in calculating the weight of refuse per day; the actual number of days in the year—365 or 366—should be used, and not the number of week days.
5. Returns for street cleaning were generally unsatisfactory. It was not always understood that when figures were asked for the cost per 10,000 square yards for street cleaning and per 1,000 catch-basins for catch-basin cleaning, it was desired that these be based on the number of cleanings rather than on the number of basins or the actual area of the street. Also, in some cases the cost of street cleaning has been partly included in that of the maintenance of highways.

The report contains summaries of the figures submitted by the 79 municipalities, and these show wide variations. Taking the quantity of refuse per thousand population per day, two showed under 1000 pounds, 14 showed between 1000 and 1300, 24 between 1300 and 1600, 17 between 1600 and 1900, 8 between 1900 and 2200, and 9 over 2200. The average for all the towns was 1660, or 1.66 pounds per capita per day, equivalent to 606 pounds per year. This is the total refuse collected, the practice in England being to collect garbage, ashes and rubbish combined.

Figures for cost of refuse collection include loan or depreciation charges and expenditures for new plant paid for out of revenue, with the income deducted. In giving prices, we have changed English money to the American equivalent on the basis of a shilling being worth 25c and a pound \$5, which gives about 3% error on the basis of the present rate of exchange and more than this on the basis of the value of money during the fiscal year 1925-1926. In eight boroughs the cost of collection was under \$1.50 per ton. In 15 boroughs it was between \$1.50 to \$2.00; in 21 boroughs between \$2.00 and \$2.50; in 13 boroughs between \$2.50 and \$3.00, and in 9 boroughs over \$3.00. The average for all the boroughs was \$2.27. On the basis of population served, the average cost was 65c per capita, the range in rate being practically the same and divided in about the same ratio as the cost per ton.

The returns from the entire 79 towns are tabulated in the report, and the averages are as follows: Total population included in the various reports, 12,613,055. The average net expenditure per ton for collection was \$2.27, for disposal \$1.06 or a total of \$3.33; or \$3.00 if we exclude loan charges and expenditure for new plant out of revenue. The net expenditures per capita per annum were 65c for collection, 28c for disposal, or a total of 93c. The net expenditure per house per annum was \$2.94 for collection, \$1.16 for disposal, a total of \$4.10.

As to the method of disposal, 15 of the municipalities used incineration alone and 42 incineration combined with one of the other methods. Fourteen used dumping on land alone and 34 used dumping in combination with some other method. Five used dumping at sea alone, and 3 in combination with some other method. Twelve used separation in combination with some other method, and 8 used pulverization combined with some other method. One reported land reclamation in connection with incineration and dumping.

Comparing the average costs of incineration, dumping on land and dumping at sea (since these are the only methods used uncombined with others), and taking only the figures given by those cities which used these methods alone, we find the following averages: Dumping at sea \$2.24, ranged from \$1.70 to \$2.72. Dumping on land averaged \$2.30, ranging from \$1.06 to \$3.85. Incineration averaged \$3.70, ranging from \$2.33 to \$5.58. The above are the expenditures per ton including loan or depreciation charges and expenditures for new plant out of revenue, and deducting any revenue.

Some of the wide differences in cost are to be attributed to errors in the returns, but a great deal to different conditions in the different towns. For instance, it is generally found that the weight of total refuse per capita is higher in mining towns than elsewhere, and that the figures of some towns include large quantities of night soil.

The reports for street cleaning included expenditures on street sweeping and watering, cleaning catch-basins, and snow removal, including loan or depreciation charges and expenditures for new plant out of revenue. These figures range from 27.3c per capita of population to \$1.37 per capita, and average 62.6c. Only nine reported expenditures for new plant out of revenue, and the average of all such

expenditures per capita of all the cities reporting was 0.3 cent, reducing the average cost to 62.3 cents.

Snow Handling in North Dakota

Snow prevention more effective than removal. Four prevention methods. Shoveling snow to sides of road ineffective in North Dakota

The winter of 1926-1927 was the first since 1922-23 that North Dakota experienced snow blockades, the three intervening winters being almost free from snow. Last winter the snow began during the forepart of December and the merchants, finding the blocked roads interfering with their holiday business, appealed to the state highway commission for snow removal.

A V-shaped plow, used chiefly between Jamestown and Fargo, was operated 432 hours over 1041 miles, at a cost of \$10.96 per hour; this cost including labor, repairs, gas, oil and depreciation. It was found that if a wind came up shortly after the plow had gone over a road the drifts became deeper than before, levelling up to the tops of the windows along the sides.

Experience in different parts of the state led to the following conclusions, published by the State Highway Department in its official monthly, "North Dakota Highway Bulletin":

Snow removal work at Devils Lake (where a V-type push plow was used) was unsatisfactory for several reasons:

1. Because the plow was run down the center of the road and no attempt to clean the entire roadway free of snow was made.
2. Because we did not have a warm garage in which to house the equipment.
3. This type of snow removal—if it can be termed such—results in the destruction of considerable road metal at the spring break-up, by impounding the melted snow on the roadway.

GENERAL SUMMARY—SNOW PREVENTION.

Snow prevention if properly carried out, will be more effective than snow removal. There are four effective methods to keep the snow off the roadway. In the order of their importance, they are:

1. Alignment, or the proper location of the roadway.
2. Grade Elevation, carrying the grade line above the adjacent ground line.
3. A clean right of way. The right of way and even beyond the right of way limits must be kept free from grass, weeds, brush, trees, rock, rubbish, or anything that will break up the wind currents and cause the snow to lodge on the roadway.
4. Snow Fence. The proper erection of a liberal quantity of a light portable snow fence to keep the drifts off the roadway.

The Highway Commission has purchased eighty-five miles of wood slat snow fence at an average price per foot, including posts, of 11.8 cents F. O. B. points of delivery. This fence, properly placed at points that have given us trouble in the past, will insure a large mileage of open road. Two carloads of this type of snow fence were purchased in 1926 and proved very effective.

SNOW REMOVAL.

Snow removal should imply entirely removing the snow from the roadway, leaving no windrow of snow on or ad-

jacent to the roadway. If this is not done it would be much better not to attempt snow removal work.

Snow removal may or may not be effective, depending somewhat upon the equipment used but chiefly upon existing weather conditions.

Weather conditions may be such that snow removal with any kind of equipment is ineffective. If snow would lie where it falls snow removal would be relatively simple. In this state with our almost constant winds, the snow keeps constantly on the move, shifting back and forth with each wind. A light fall of snow can cause a great deal of trouble if followed by high winds.

On roads where the grade lines are level with or below the adjacent ground line, snow removal work is impractical excepting with equipment of the blower type, that delivers the snow a considerable distance from the shoulder of the road. To pile the snow up in windrows on or near the shoulders of the road is only aggravating the situation and ultimately increasing the depth of snow on the roadway. This kind of work also results in a loss of surface material during the spring breakup and may mean the utter ruination of the road surface.

Snow removal machinery must be housed in a warm place where it is ready to go at any time, and should be kept in continuous operation while out in the cold. It is not feasible to attempt snow removal unless a warm place is provided where the men can overhaul the equipment when it is not in actual service. Equipment engaged in this work during sub-zero weather needs very close attention, proper attention can not be given in cold storage nor is equipment housed in a cold place in condition to operate.

Snow removal equipment in order to be effective, must move rapidly between drifts; drifts sometimes being miles apart, considerable time is lost if equipment moves only 2 to 3½ miles an hour.

Care must be exercised in operating a snow plow so as not to shove loose gravel over the shoulder of the road. At least two inches of snow should be left on the road surface to guard against this loss of gravel.

Sewer Connections in San Francisco

For many years all sewer connections in San Francisco, Calif. were constructed when the main sewer was completed, but in many cases building operations did not follow up the sewer construction and paving, and the connections represented an idle investment, as many were not used for some time and others could not be located in after years when needed. Because of these facts, the requirement of installing connections previous to paving was removed several years ago.

With the rapid building up of the city, whereby buildings are following closely after the paving, it was found that the new pavements, while still green, were being cut for sewer connection installations; and a base or pavement, when once cut into, is difficult to maintain. A return to the old system will be made shortly as it is the opinion of the city engineer that, considering all phases of the problem, the economic loss will be less if connections are installed before pavements are constructed, even if some are "lost" or not used immediately. In addition, the initial cost to the property owner will be less for, with all the connections in a block being installed at the same time and before the pavement is laid, a better price can be offered by the contractor than where connections are constructed singly and the pavement must be cut.

On July 1, 1925, a schedule of prices per lineal foot by districts for installing sewer connections was put into effect. This replaced the system of collecting in advance an estimated cost of installa-

tion with an additional sum collected or a rebate made if the actual cost exceeded or was less than the estimate. Under this schedule, the pipe and cement is supplied by the city, whereas formerly the property owner had to provide these materials.

After the schedule had been in effect for six months, sufficient data had been obtained upon which to base more detailed estimates of cost, which resulted in a raise in the prices fixed.

During the fiscal year, 1925-1926, 2,772 applications for sewer connections were made (many ap-

plications covering two or more sewers) and \$177,112.37 collected for installing them. While the number of applications received was the same as for the previous year, the collections were less by \$36,313.06. This is accounted for by the fact that the previous years' collections were gross collections from which rebates were made later, due to estimates exceeding the determined cost, and also because under the first lineal foot price schedule adopted and in force over six months, it was found that the sum collected was far less than actual cost.

Digestion of Sewage Screenings

By H. Heukelekian*

The digestion of screenings from a fine screen, seeded with ripe sludge, was tried out with and without fresh solids. Lime was added to a duplicate series to adjust the reaction to a pH value of 7.4. To a 2:1 mixture of fresh solids and ripe sludge 11.2% screenings were added on the basis of volatile matter. The mixture of screenings and ripe sludge had a ratio of 1:1 on the basis of volatile matter. Frequent gas measurements and occasional gas analyses were made. Solids and ash were determined in the beginning and at the end.

The results indicate that the digestion of screenings, either separately or in conjunction with fresh solids, is feasible. The rate of digestion of screenings was as rapid as that of the screened fresh solids. The volume of gas produced from screenings was as high as that from fresh solids.

This study was undertaken with the purpose of determining the feasibility of digesting screenings. It was of interest to find out the rate of digestion, or in other words the increase in the capacity of the digestion tanks, that would be necessary as a result of including the screenings. It was also of interest to determine the gas production from this material for the purpose of utilization.

METHODS

The screenings from the Reinsch-Wurl screens at Plainfield were brought to the laboratory and finely ground. This precaution was taken primarily to secure better samples for analyses, although a finer division of the particles might be beneficial for digestion as well. Fresh solids and ripe sludge were obtained from the same location and three different mixtures were prepared. The first one was a mixture of fresh solids and ripe sludge in the ratio of 2:1 on the basis of volatile matter. This mixture served as a control. To the above mixture in another bottle 11.2 per cent screenings were added on the basis of volatile matter. The third mixture was made up with screenings and ripe sludge in the ratio of 1:1 on the basis of volatile matter. To a duplicate series of the above mixtures, lime was added to adjust the reaction to pH 7.4. As these were all connected with gas measuring apparatus and could not be opened while the experiment was in progress, frequently pH determinations were made on a series of dummies

from which the amount of lime to be added to the bottles was calculated. Lime was added to the bottles through a check valve so that no air could enter. Frequent gas measurements and occasional gas analyses were made. Solids and ash were determined in the beginning and at the end.

RESULTS

The daily records of gas production from these bottles are given in an accumulative form on the basis of a gram of volatile matter in fig. 1. The daily increments of gas are more or less alike for the limed and unlimed mixtures of fresh solids and ripe sludge mixtures; being slightly

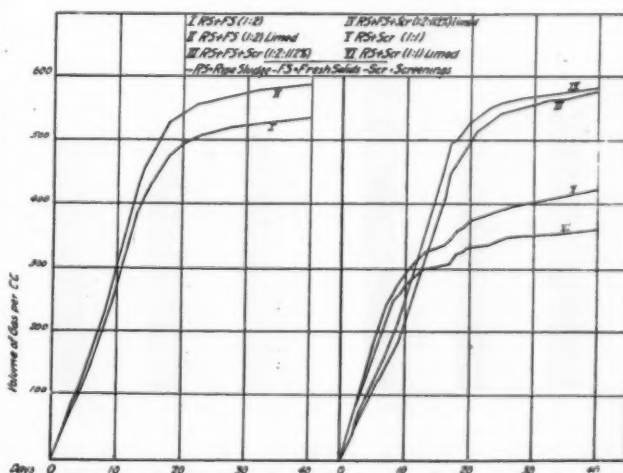


FIG. 1—VOLUME GAS PRODUCED PER GRAM OF VOLATILE MATTER IN (1) RIPE SLUDGE—FRESH SOLIDS, (2) RIPE SLUDGE—FRESH SOLIDS—SCREENINGS AND (3) RIPE SLUDGE—SCREENINGS MIXTURES

*Bacteriologist, N. J. Agricultural Experiment Station.

†The term "fresh solids" is used to describe the material collected by sinking pails in the flow chamber of an Imhoff tank, which gives the settling solids of the screened sewage.

higher in the former. The maximum production took place in 20 days, after which only small amounts of gas were produced. As far as gas production goes, the digestion in this mixture was complete within 20 days.

That the digestion of screenings in conjunction with fresh solids is entirely feasible is indicated from curves III and IV in fig. 1. The rate of gas production in the limed series was only slightly higher than the unlimed. These curves are almost identical with the curves for ripe sludge and fresh solids mixtures (fig. 1, curve I and II) within a difference of a few days. The volume of gas produced from the two series is equally high. The difference between the limed and unlimed series in this case is not as great as in the mixture of fresh solids and ripe sludge alone.

The mixture of screenings and ripe sludge (fig. 1 curves V and VI) is not comparable to any of the others in this experiment because it had a ratio of 1:1 on the basis of volatile matter and consequently had relatively less raw material than the others. The maximum gas production was completed in about 15 days and surprisingly the limed series produced somewhat less gas than the unlimed. This would indicate that lime is not as necessary for the digestion of screenings as for fresh solids.

Gas production per gram of volatile matter in the raw substances added to the different mixtures was calculated and is represented in fig. 2. This was done in order to compare the ripe sludge and screenings mixture with the rest of the series. The addition of lime to all the mixtures resulted in greater gas production with the exception of the screenings and ripe sludge mixture. Gas production per gram of volatile matter in the screenings (unlimed series)

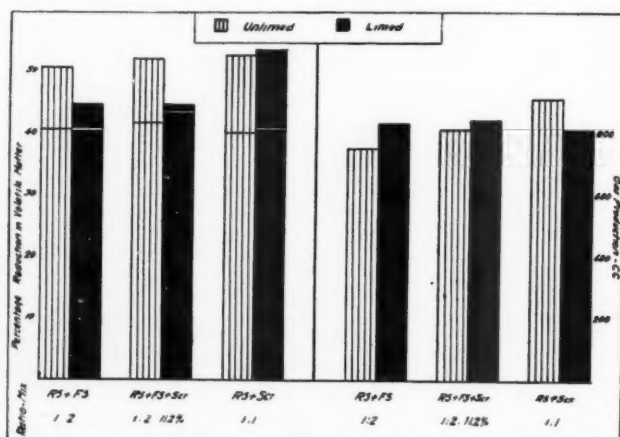


FIG. 2—PERCENT VOLATILE MATTER REDUCTION IN 40 AND 60 DAYS AND VOLUME OF GAS PRODUCED PER GRAM OF VOLATILE MATTER IN THE RAW MATERIALS ADDED IN THE DIFFERENT MIXTURES

was higher, than that of the corresponding series with the fresh solids. This might have been expected, as the screenings are rich in gas-yielding carbonaceous materials than the fresh solids.

When the screenings were included with the fresh solids, gas production per gram of volatile matter in the raw materials was again higher than that of fresh solids alone. In this case the addition of lime was slightly beneficial.

In the same figure are given the percentage reductions of volatile matter for these different mixtures in 40 and 60 days. These figures show the same general tendencies as previously deduced in the discussion of gas production. The reduction of volatile matter in the limed and unlimed series of ripe sludge and fresh solids mixture was equal for the 40 day period. The reduction in the limed and unlimed series of ripe sludge-fresh solids-screenings mixture as well as in ripe sludge-screenings mixture was about the same as in the ripe sludge-fresh solids mixture. The fact that after a 60 day digestion period the volatile matter reduction in the unlimed series is higher than in the limed, in the fresh solids and ripe sludge mixtures as well as in the one with an additional 11.2 per cent screenings, is signifi-

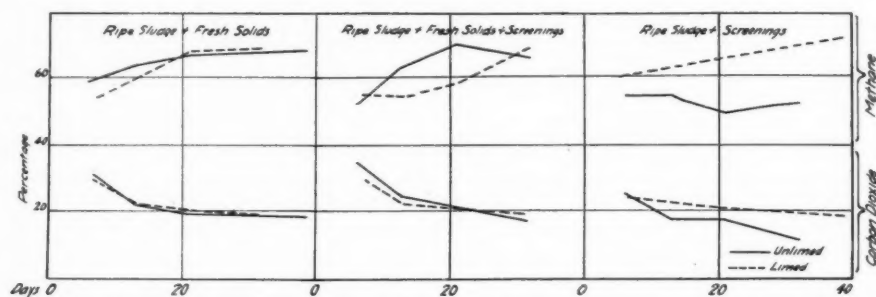


FIG. 3—COMPARISON OF THE PERCENT METHANE AND CARBON DIOXIDE IN THE GAS FROM THE DIFFERENT MIXTURES

cant. After the active gas production stage is over there is a greater reduction of volatile matter in unlimed than in limed mixtures.

About equal amounts of lime were necessary for the digestion of screenings and of fresh solids. This is significant, since it was expected that the digestion of screenings would give rise to higher acidity. Obviously the nitrogenous substances in the feces are enough to counterbalance the carbonaceous materials.

The gas analyses made during the active gas production period on the different mixtures of fresh solids, screenings and ripe sludge are given in fig. 3. The methane and carbon-dioxide curves of the fresh solids and ripe sludge mixtures indicate a normal trend, the first increased and the latter decreased as digestion proceeded. There was no significant difference between the limed and unlimed series. The CO_2 in the above mixture with additional 11.2 per cent screenings was the same as in the control, but the percentage methane content showed some divergence. In the unlimed material it increased normally up to about 70 per cent but in the limed material it was

low until the end of the active gas production period, when it came to the same level as the unlimed.

In the ripe sludge-screenings mixture the CO_2 was low both in the limed and unlimed material. The methane content of the limed material was normal, but of the unlimed was below normal.

From the above discussion it will be evident that the digestion of screenings is quite feasible. The digestion of fresh solids is not materially affected when a large percentage of screenings are included. Further, the digestion of screenings without the admixture of fresh solids is possible. Under practical conditions the elimination of fine screens and the digestion of all the solids received would be more economical than the addition of screened solids to the tanks. In doing this, due allowance must be made for the augmented amount of solids to be digested by increasing the per capita digestion capacity in proportion to the amount of solids in the screenings.

CONCLUSIONS

1. The digestion of screenings, either separately or in conjunction with fresh solids, is feasible.

2. The rate of digestion of screenings is as rapid as that of the screened fresh solids.

3. The volume of gas produced from screenings is as high as that from fresh solids.

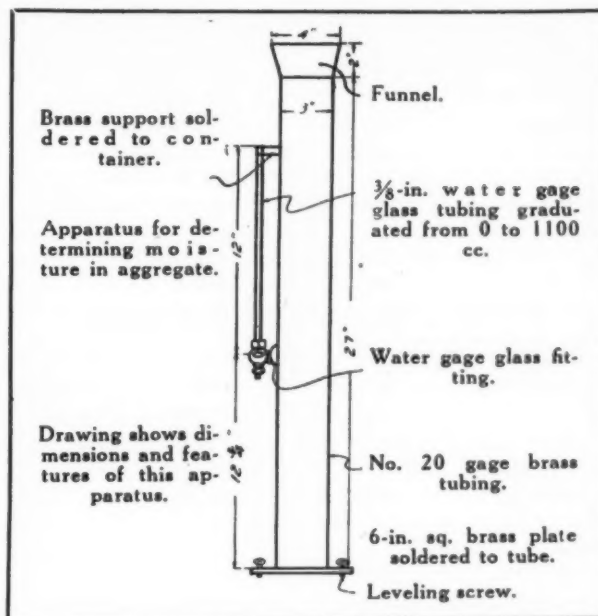
It must be borne in mind that the above refers only to screenings from a fine screen—in this case a Riensch-Wurl. Mr. Heukelekian informs us that, from a general consideration of the type of material caught by a coarse bar screen, it would seem that such material could be taken care of in the same way as suggested for the fine screenings referred to in the paper, but that it is not to be expected that the digestion of this material would proceed at the same rate as that of fine screenings, as the crude, unprocessed cellulose in the rags and papers caught by a coarse screen would not digest as readily. Furthermore, from the sewage plant operator's standpoint, there would be the danger of clogging up the pipes by introducing such coarse material.

Determination of Moisture in Aggregate

When accurate control of the mixing water for concrete is to be maintained, a quick, simple method of determining the moisture content of the aggregate is desirable. The laboratory of the Portland Cement Association has developed a special apparatus for making this test.

The method used is based on the fundamental principle of the difference in volume of water displaced by dry and moist sand. The volume of dry sand may be assumed to be constant so long as the grading, unit weight, and specific gravity of the sand do not change materially.

There are several types of apparatus which may be adapted to this method. The apparatus described consists of a cylindrical brass container with a gage glass attachment as shown in the accompanying sketch. The container is 29 inches long



APPARATUS FOR DETERMINING MOISTURE CONTENT OF AGGREGATE

and 3 inches in diameter with a funnel top 2 inches high and 4 inches in diameter, and will accommodate a 5 pound sample of sand. The container is carefully calibrated in cubic centimeters with the graduations marked on the gage glass.

To make the test, the container is filled with water to the 0-cc. mark on the graduated gage glass. A convenient weight, usually a 2000-gram sample, of dry sand is then placed in the container and the volume of water displaced is determined immediately by direct reading of the water level in the gage glass. This procedure is then repeated using the same weight (2000 grams) of damp sand and the volume of water displaced noted. The percentage of moisture is calculated by substituting the volumes of water displaced by the dry and damp samples, together with the weight of the sample in the following formula:

$$P=100 \frac{D-C}{W-D}$$

In which P = percentage of moisture by weight of dry sample,

D = volume (in cc.) of water displaced by damp sample,

C = volume (in cc.) of water displaced by dry sample,

W = weight of sample (dry or damp).

If the weight of sample is measured in pounds, this weight must be converted to grams before substituting in the formula. (One pound=453.6 grams).

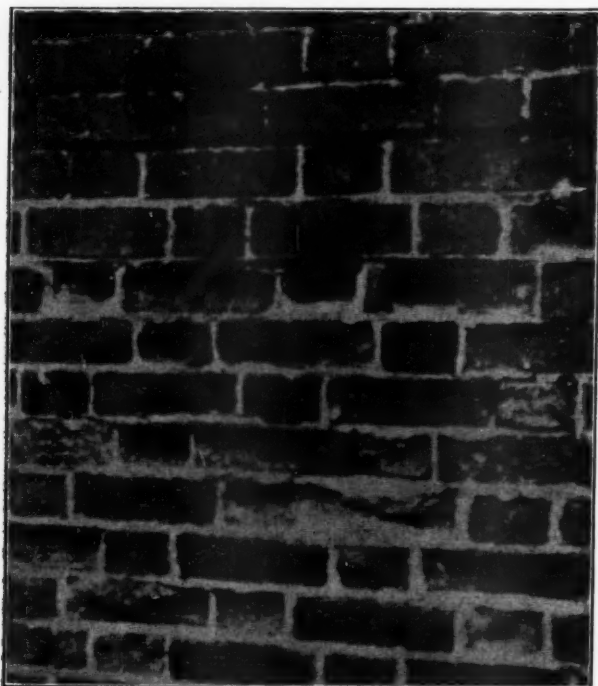
When placing the sand into the container it is essential that all entrained air be eliminated. This can be done by placing a small piece of wire coiled at one end in the container and carefully withdrawing it as the sand is poured in. In order to avoid errors due to absorption of moisture by the dry sand, it is necessary to read the displaced water immediately.

This method of determination has been found to be accurate within 0.5 per cent of moisture, provided the operator exercises care in the weighing of the samples and reading of the water levels in the gage glass. This method is advantageous because it gives the surface moisture and obviates the necessity of correcting for absorption of the aggregate which is necessary when the method of drying the aggregate is used. The moisture determinator may be used for both sand and coarse aggregate.

Pointing Masonry With Cement

Experiments being carried on by the Building Research Station of the Department of Scientific and Industrial Research at Garston, England, include investigations into the weathering and other agencies of decay of stone and brick work. One theory now being studied is that the rate of evaporation of the materials used affects the problem. Speaking on this subject before the municipal and county engineers recently, Dr. W. N. Thomas, a member of the staff of the station, said that there was an important application of this in the repointing of old work. In many cases of old stone and brick buildings, where the lime mortar joints had disintegrated while the stone had remained fairly good, the joints had been raked out and repointed in a hard, impervious cement mortar. The joint being much more impervious, and the rate of evaporation much less than that of the stone, the free lime which was formed during the setting of the cement was drawn into the stone from the mortar. This being converted into sulphate had often caused the stone to decay and the hard mortar joints are left protruding.

The accompanying photograph shows a por-



DECAY OF BRICKWORK DUE TO POINTING WITH A HARD, IMPERVIOUS MORTAR

tion of a brick wall, the lower portion of which, up to about 6 ft. from ground level, had been pointed in a hard Portland cement mortar. It will be noticed that the bricks at the top were in good condition, while the old lime mortar had crumbled away for half an inch to an inch from the face. In the lower portion the hard mortar remained protruding while the bricks had disintegrated. Rates of evaporation were therefore of importance in the study of weathering, and a research into the phenomena of evaporation was in hand.

Disintegration was often attributed to the action of frost, but in a great many cases the primary cause was more often some other agency, such as the crystallization of salts. Work was, however, being carried out to devise a satisfactory frost test. It had been suggested that, as water expanded 9 per cent when forming into ice, then if 9 per cent of the pore spaces remained unfilled when the material absorbed water, no damage would occur. A margin had to be allowed on account of the uneven distribution of the water, and practice seemed to indicate that if more than 80 per cent of the pore spaces were filled, damage was likely to be caused—i. e., if the "coefficient of saturation" was more than 80 per cent.

Construction Work on Atlanta-Macon Road

The Atlanta-Macon road, designated as U. S. Highway No. 41, carries Florida-bound traffic for 97 miles through Georgia from the middle west as well as local traffic between Atlanta and Macon. It was made an all-paved road in 1926 by closing up all gaps, 40 miles of concrete having been under construction at one time. The Whitley Construction Co. built 9.2 miles; south of this the Davis Construction Co. had a 12.6-mile contract. Beyond this was 3½ miles already built, and a 12-mile stretch south of this was built by Bibb county employees. Five miles was completed last year by the Pittman Construction Co., and 2.5 miles by Hopper & Winston. This gives a continuous stretch of concrete between Atlanta and Macon except for about two miles of brick in Griffin.

The concrete pavement was made 18 feet wide, 9 inches thick on the edges and 6 inches in the center. The concrete was proportioned 1:2:3½. No center or expansion joints were used; but at night or at any other time when it was necessary to make a construction joint, the slab was made 9 inches thick on both sides of the joint, tapering back to 6 inches. This not only added strength to the joints but probably prevented water which seeped through the joint from running under the pavement.

The Whitley Construction Co. began work in May, 1926, and averaged 309 lineal feet per working day.

Materials were hauled in trucks from a central

proportioning plant. The town of Milner proved an ideal location for the plant as it was almost exactly in the center of the project, making the maximum haul in each direction $4\frac{1}{2}$ miles and the average haul $2\frac{1}{4}$ miles.

A fleet of 23 Ford trucks, each hauling one 5-sack batch, was required to keep the mixer busy. Work was started with a Smith mixer but the contract was completed with a 28-E Koehring which handled 6-sack batches.

The proportioning plant consisted of a Butler steel bin divided into sand and stone compartments with volumetric measuring boxes beneath. Materials were unloaded from cars and placed in the bin or in storage piles with an Orton and Steinbrenner industrial crane with a 40-foot boom and $\frac{3}{4}$ yard clamshell bucket. To facilitate unloading, a pit was dug under the edge of the track and stone, shipped in bottom-dump cars, was dumped directly into this pit, from which the crane picked it up. The advantage of this arrangement was that the clamshell could always get a full load and the labor of "cleaning up" in cars was reduced.

At the mixer, the equipment consisted of a 10-ton roller, a turntable for turning loaded trucks, Blaw-Knox forms, an Ord finisher, which was followed by a hand belt, and the usual small tools.

The organization consisted of 58 men divided as follows: 1 superintendent, 4 foremen, 1 craneman, 16 skilled laborers and 36 common laborers.

The Davis Company also hauled with trucks from a central proportioning plant. Railroad facilities were such that it was necessary to haul from the western end of the job for a portion of the pavement and from near the eastern end for the balance, making an average haul of $2\frac{1}{2}$ miles. Three batches were hauled at a time by White trucks. The con-

tractor had two construction jobs in operation at the same time and was able to arrange them so that when there was a long haul on one job, there was a short one on the other. Then he shifted trucks between jobs so that he always had enough to keep the mixer busy. On the maximum haul, which was 5 miles, 14 trucks were used.

The proportioning plant consisted of a gravity bin with volumetric measuring boxes and a cement house. Cement was dropped into the three compartments in the truck from cement hoppers hung beneath the floor of the cement shed. When a truck had backed into position under the hoppers a lever was pulled which opened all three valves and allowed the cement to drop into the truck in one minute, saving two or three minutes as compared with the ordinary method of holding the truck while individual sacks are dumped. Two cement handlers dumped into the three hoppers the five sacks of cement necessary for each batch. Other men were needed when the cement was being brought from cars to the hoppers.

All the machinery was operated by gasoline engines. At the proportioning plant the contractor erected a gasoline tank which would hold a carload of fuel, which made it possible to buy gas at "tank car" rates and save considerable money.

The mixer used was a 21-E Rex paver, which was followed by an Ord finishing machine, a Macon roller and a finishing belt. On the later part of the work a longitudinal float, operated from two bridges which spanned the pavement, smoothed out all transverse ridges left by the other finishing tools and made the surface exceptionally smooth-riding.

The Davis Company began work in April, 1926, and, averaging 421 feet of pavement per ten hour day, completed their contract December 3, 1926.

Light Asphaltic Oil Road Surfaces

In the November issue we gave a summary of the information obtained and opinions reached on the subject indicated by the above title by Federal and state investigators, as given in the official publication of the Bureau of Public Roads. Supplementing this, the Bureau report gave in considerable detail the methods of conducting the investigation, the conditions found in each of the roads examined, and the bearing of each upon the conclusions reached. The more important points of this matter are abstracted briefly below.

SURFACE OILING

In Oregon practice, immediately after sweeping, the majority of the sections were treated with the oil in two applications with an interval of two or three days between them to permit the first to penetrate. In general, the first application was at the rate of three-tenths, and the second at the rate of two-tenths gallon per square yard.

During 1926 this treatment was varied by the substitution of a heavier oil or tar for the second application in the treatment of over 130 miles of road. On these sections the first application consisted of about one-fourth gallon per square

yard of the 60 to 65 per cent asphaltic oil, followed in most cases by an application of one-fourth gallon of oil containing 70 to 80 per cent of asphalt of 80 penetration. In other cases a tar was used for the second application, the material being prepared from crude tar obtained in the manufacture of gas from petroleum oil. Reports received in February, 1927, indicate that these heavy oil treatments have made a good showing during the winter in sections where snowfall was heavy.

The cover material has sometimes been spread from trucks by opening the end gate an inch or so and driving rapidly over the oiled surface.



MECHANICAL SPREADER HAVING WHIRLING DISKS TO DISTRIBUTE SCREENINGS OVER ROAD SURFACE

In other instances mechanical spreaders have been used.

Maintenance in Oregon begins immediately after the final oiling. At this state, brown areas appear where there is a deficiency of oil, the result generally of the picking up of the surface by steel tires or of sandy spots in the surface. These are spotted with oil, and any depressions that may require it are filled with additional chips and oil.

Thereafter the maintenance men patrol the road, carrying with them a supply of chips and oil or premixed oil and chips. Holes or depressions are filled as soon as they appear, care being taken to use no more filling material than is needed to bring the patch flush with the surrounding surface and avoid transforming the depression into a hump. The experience thus far indicates that a two-man patrol can cover 50 miles or more of road, performing the work described.

Figures presented show that the cost of maintaining untreated crushed rock surfaces on several projects, under an average traffic of 500 vehicles a day, averaged \$402 per mile per year; and that the cost of replacing the surfacing material destroyed by traffic and weather was \$1,351 per mile per year—a total of \$1,753 per mile per year, or an average annual charge of \$3.50 per mile per average daily vehicle.

The cost of maintaining these surfaces after oiling, during 1926, which was the only com-

plete year covering all projects, averaged \$333 per mile, a figure which includes some reoiling.

The cost of two applications of light oil and screenings on a 66-mile section in Oregon was \$690 a mile, which is assumed to have a life of three years. The cost of oiling is thus less than that of replacing one year's loss of surfacing material on unoiled roads, and the cost of maintaining oiled surfaces is no greater than that of ordinary maintenance of untreated surfaces under lighter traffic.

Investigation of a large mileage of roads demonstrated the great importance of the nature of the binder used in original construction.

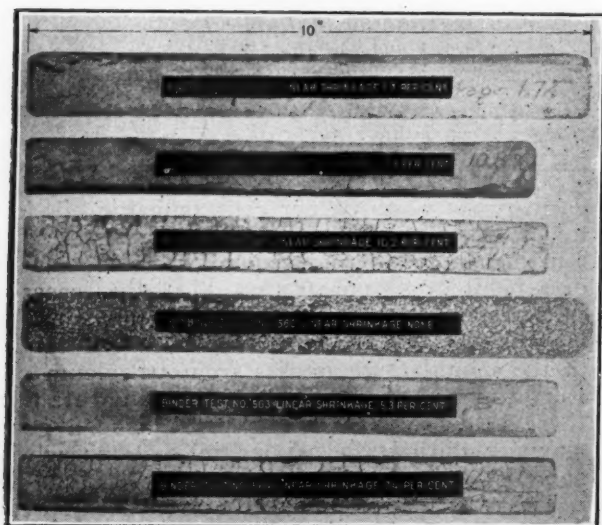
In explanation of the apparent importance of the character of the binder as an element in the success or failure of the oil treatment, it may be observed that the treatment produces an air and water tight surface which, although it prevents entrance of water from above, also serves to prevent the escape of moisture brought up from the subgrade by capillarity. The concentration of moisture beneath a waterproof surface has often been observed; and it may be anticipated that an increase in the moisture content of the surfacing will follow oil treatment. Under these conditions it is logical to suppose that a binder possessed of high water-carrying capacity and a tendency to expand greatly and become unstable with increase of moisture would affect the stability of the surface.

The binder that had been used in the different roads was tested for lineal shrinkage and field moisture equivalent, each of which should be low in satisfactory binder; it was also tested for cementation. In practically every instance an excess of clay was found in samples taken from surfaces which were pushing or corrugating. No such defects were found in any of the sections which had been bound with volcanic ash soil or with fines obtained in quarries or gravel pits.

The limits suggested for the field moisture equivalent and lineal shrinkage tests were a field moisture equivalent percentage of 20, a lineal shrinkage value of 5 and a cementing value of 100 pounds per square inch.

"The study of the tests of surface-treated material seems to show quite conclusively that stability is best obtained where the road is well bound under traffic without the use of sticky, heavy clays. The amount of bituminous material required is small. It is quite apparent that stability in the surfacing is more dependent upon the stable character of the road material than upon the amount or kind of oil used."

The practice in California during the latter



TYPICAL SPECIMENS FROM TESTS TO DETERMINE THE LINEAR SHRINKAGE OF BINDER MATERIAL



MULCHING PARTLY BLOWN BACK OVER OIL SURFACE

part of 1926 was to blade the mulch into rows along the shoulders, sweep thoroughly with a power broom until all loose material was removed and the surface of the rock exposed, and make two applications of oil, each of about $\frac{1}{4}$ gallon, a few minutes apart; 10 to 30 minutes after which the mulching was bladed back over the fresh oil.

In the drier climates, where considerable penetration is desired, the light grade of "fuel oil" has given excellent results. In sections where rainfall is heavy, it has been found that the heavier "fuel oil" should be used, at least in the surface coat. Heavy oil, however, requires more screenings than light oil, and is, therefore, more costly. In certain localities a first application of light oil followed by an application of heavy oil will accomplish the desired results and keep the cost of screenings at a minimum. It is apparent, therefore, that the selection of the bituminous material requires careful consideration.

A nonskid texture can be secured on a road which is bound with stone dust or inert binder by sweeping before treatment until the stone particles are exposed. A covering of screenings on the last coat of oil improves the texture.

Accurate cost data as to maintenance of crushed rock and gravel roads thus treated with light "fuel oil" are not yet available, but indications point to a cost of \$300 per mile per year with traffic of about 500 vehicles.

Freshly oiled surface is readily damaged by iron tires which pick up the oil and leave bare tracks that do not entirely heal. Rubber tires do not appreciably damage such a road; but a reckless driver on a freshly oiled surface not only endangers himself and his own property but is a menace to others. Skidding upon the recently oiled roadway has caused several accidents. Also it is very difficult to drive a car over such a surface without spattering it from end to end with oil. The cleaning of a car in this condition costs from \$5 to \$10, and a considerable loss in the aggregate may result to motorists on a road carrying heavy traffic.

Where traffic can not be detoured but is carried on a road under treatment, traffic control is ordinarily installed. Such a control system, it is suggested, should consist of special officers stationed at each end of the freshly oiled road. The officers should stop each car and present the driver with a ticket showing the time at which the car will reach the other end of the control if operated at a speed of not more than 8 miles per hour. The driver should be told that he will not be permitted to pass the control at the other end until the time indicated. Merely cautioning the drivers is not sufficient, as has been demonstrated in many cases.

SURFACE MIXING PROCESS

This process, as practiced in California, was described in the October issue of PUBLIC WORKS under the name of the "turnover method." It was first used in Wisconsin in 1923, when tar was used.



POWER BROOM ATTACHED TO FRONT END OF TRACTOR USED FOR CLEANING SURFACE BEFORE APPLICATION OF OIL

For this construction, the presence of heavy clay binder is objectionable but the proper amount of fine inert filler is an advantage.

The viscosity of the oil used is an important factor in this process. It must not be too heavy to mix with the road metal readily at prevailing temperature. Quantity is even more critical; an excess results in rutting and other displacement; a deficiency causes raveling. Heretofore the only gauge has been the appearance of the mixture, but the similarity to other asphaltic types and the expense and unreliability of cut-and-try methods suggest the possibility of utilizing a modified form of the stain test, once common in sheet asphalt practice. Experiments along this line have been very promising. Uniformity is difficult to attain because inevitably the thickness will vary from place to place, and with uniform application of oil the result will be an irregular richness. If the irregularity is sufficient to be observed during the construction process, additional fine material beneath the richer portions should be loosened and incorporated into the oiled material.

An empirical formula has been developed which is tentatively submitted with the thought that it may be of value in estimating the amount of oil required. The formula is:

$$P = .015a + .03b + .17c$$

in which P is the percentage of oil required, a is the percentage passing the 200-mesh sieve, b is the percentage of metal passing the 10-mesh and retained on the 200-mesh sieve, and c is the percentage of metal retained on a 10-mesh

It is not applicable to porous or absorbent



EXPOSED ROCK SURFACE UPON COMPLETION OF BROOMING

materials such as cinders or lava but otherwise it appears to give results which are consistent with service obtained from various mixes. The stain test apparently furnishes the only reliable means for determining the amount of oil required for absorbent materials.

Used with non-absorbent materials, the proportion of oil calculated from the formula has furnished satisfactory stains from many mixtures prepared in the laboratory; but even with such materials, the indications of the stain test seem to be a more reliable guide than the formula in case of conflict between the two methods.

Stain test.—Inasmuch as the success of the surface-mixing method depends upon correct gauging of oil requirements and upon uniform mixing, an attempt was made to find a field test which would be of value to those carrying on such work. Resort was had to a modified form of the pat stain test used for many years in the control of sheet asphalt mixtures. This stain test can not be made on samples containing coarse sand or gravel. It is, therefore, necessary to prepare samples for test by removing coarse particles, and it is also necessary that the samples be heated. The stain test as finally developed is described as follows:

The sample from the roadway is first warmed.

Sample 106—Oiled earth road; fine silty soil treated with 4 gals. of oil per square yard; very high percentage of fines. Proportion of oil to sand 9.4%. Amount of bitumen just sufficient to coat particles and secure the necessary binding.

Sample 110—Oil-treated crushed gravel; sand somewhat coarser than in 106 and amount of bitumen required therefore less, satisfactory stain, produced by oil 8.4% of material passing 10 mesh sieve.

Sample 111—Oiled sand shoulder; very small percentage of dust passing 200-mesh, moderate amount passing 110-mesh. Oil 3% higher than in 106—stain clearly shows an excess.

The fine material is then separated from the coarse by passing through a 10-mesh sieve. This can be readily accomplished by rubbing gently with the fingers and by loosening the fine particles that adhere to the coarse. The particles which do not pass the 10-mesh sieve may be discarded. The original sample should be of sufficient size to provide about 1 pound of material passing the 10-mesh sieve. This 10-mesh material is heated to approximately the boiling point of water, which may be conveniently accomplished by placing the sample in a fruit jar or can and allowing it to remain partially submerged in the boiling water for a period of about one hour. The heated mixture is then dumped in a pile on the center of a sheet of white type-writer paper and leveled to a thickness of about 1 inch, when another sheet of paper is placed on top. A wooden block 2 inches thick is placed on top of the paper and to this are delivered five blows from a 2-pound hammer, falling freely for a distance of about 1 foot. The two papers are then removed from the asphaltic mixtures and the stain produced indicates the relative amount of oil in the sample.

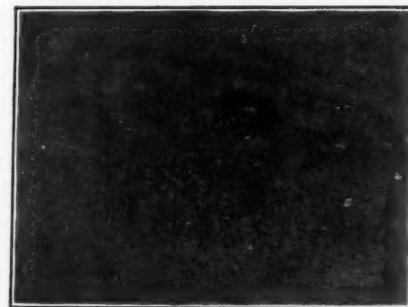
Satisfactory surface mixtures will produce a light yellowish brown stain, in which the impression of the individual sand particles may be distinguished and which is not blurred or blotched. A heavy stain

Sample 113—Oiled sand roadway; sand much coarser than other samples, approximately concrete sand; fines almost entirely lacking. Normal stain produced by 4½% oil. Amount of oil entirely sufficient and road satisfactory.

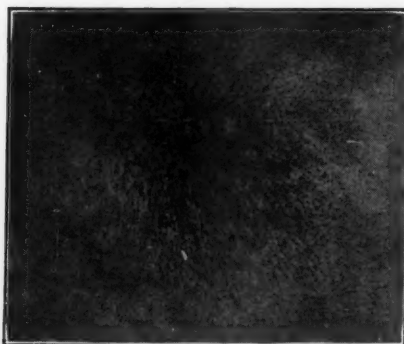
Percent of Sample Passing Sieves of Different Meshes				Grading of Material Finer Than 10-Mesh			
Grading of Total Sample				Number of Sample			
Size	106	110	111	Size	106	110	111
200-mesh...	43.8%	11.0%	4.6%	200-mesh...	43.8%	24.0%	4.6%
10-mesh...	99.8%	45.8%	97.1%	100-mesh...	55.6%	38.2%	24.0%
3-mesh...	100.0%	82.4%	98.0%	50-mesh...	82.2%	50.7%	50.2%
¾-inch...	.....	95.8%	100.0%	40-mesh...	89.2%	56.6%	73.3%
½-inch...	.....	97.5%	.....	30-mesh...	93.3%	62.9%	88.2%
¼-inch...	.....	100.0%	.....	20-mesh...	98.1%	74.5%	97.1%
1-inch...	.....	100.0%	.....	10-mesh...	100.0%	100.0%	100.0%

Bitumen Found in Samples.

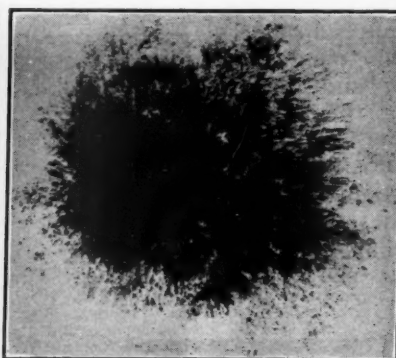
No. 106—9.4 percent of total sample; 9.2 per cent theoretical requirement.
 No. 110—4.6 percent of total sample; 3.7 per cent theoretical requirement.
 No. 111—12.4 percent of total sample; 4.1 per cent theoretical requirement.
 No. 113—3.4 percent of total sample; 3.3 per cent theoretical requirement.



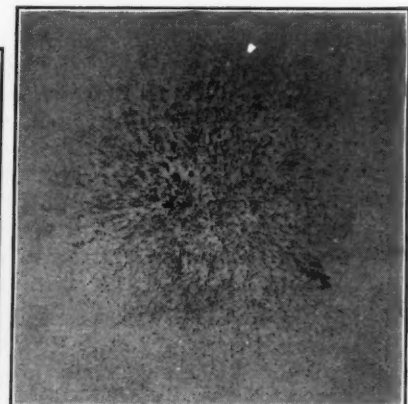
TEST NO. 110-VIII—IMP.-26-C.
Crushed gravel treated by mixing method; bituminous surface, 2½ inches thick



TEST NO. 106, COACHELLA VALLEY—RIVERSIDE COUNTY
Oiled dirt road (mixing method) treatment about 5 inches thick



TEST NO. 111-VIII Im.-27-B
Oiled blow sand; shoulders adjacent to pavement soft and loose



TEST NO. 113-VIII—Imp.-12-A
Sand-oil detour road; bituminous treatment, 7½ inches thick

TYPICAL OIL STAINS

indicates the presence of excess oil, which is not only uneconomical but also causes displacement under traffic. The illustrations show stains of samples of four completed surface mixtures.

SELECTION OF TREATMENT

Method of surface treatment.—The method of surface treatment is adapted to compacted material only. Usually a road is in best condition for treatment after having been subjected to traffic for a time. However, new surfacing material, if thoroughly compacted with water and traffic during construction, is very satisfactory. Being somewhat porous, such new material absorbs oil readily.

An old road containing considerable coarse material, if it can be repaired well in advance, is well adapted to surface treatment because the large stones are well anchored.

Method of surface mixing.—This treatment is adapted to any crushed rock or gravel road which is in need of the addition of considerable new material to restore its thickness, or which, because of lack of binder or climatic condition, is not tightly bound.

The surface-mixing method is the only one that is adapted to the treatment of a loose surface; but in the use of this method, as in surface treatment, the base course should be thoroughly compacted. The presence of material larger than 1 inch presents mechanical difficulties.

Where traffic can not be kept off the road during the time required for absorption of oil applied by the surface treatment method, the surface-mixing method is especially attractive. If the oil be partially mixed with the metal immediately after application, traffic can pass through without difficulty. The loose surface encourages slow driving, whereas the firm surface always present in the other type of treatment tempts rapid driving and the consequent spattering of oil on vehicles.

Many existing projects have lost so much material that renewal is required before treatment. If enough remains for a base, it may be repaired and shaped, covered with approximately 2 inches of material passing a three-fourths or 1-inch circular opening, and treated by the mixing process immediately.

Either type.—A well compacted, fine crushed rock or gravel surface of adequate thickness may be treated successfully by either method. Choice depends upon relative service and life, about which there is no definite information. The mixing treatment will cost more than the surface treatment, and, therefore, must show a correspondingly longer life or lower maintenance to justify its use. The surface treatment, if not thoroughly successful, can later be converted into a mixed treatment, with a final cost not greatly exceeding that of an original mixed treatment.

Emergency treatment.—A problem frequently arises with the discovery that untreated material is being dissipated so rapidly that a few months' delay will bring complete failure. Usually a large proportion of the original material has already been lost. If restoration to full original thickness or substitution of a heavier type of surfacing can not be done immediately, it may be expedient to oil the

metal remaining to prevent its complete destruction. Some failures may be expected but can not reasonably be charged to the treatment.

SELECTION OF OIL

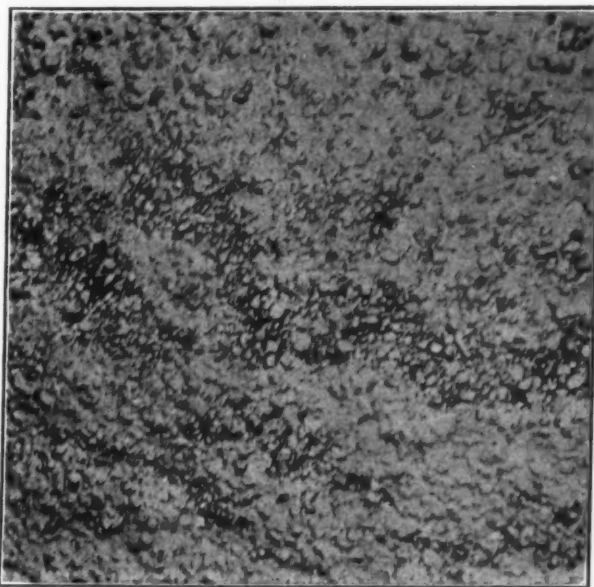
In the treatments above described the bituminous material used has been that known locally on the Pacific coast as "fuel oil," or the lightest grades of "road oil." Both are asphaltic base products.

The material sold as "fuel oil" has an asphaltic content up to about 70 per cent and a viscosity, Saybolt-Furol, up to 300 at 122° F. The term "road oil" has been applied to oil residuum having an asphaltic content of 70 to 98 per cent. "Fuel oils" are considerably cheaper than the "road oils" or asphalt, penetrate readily, and are more easily reworked.

Viscosity may vary widely independently of asphaltic content, which permits selection of various grades for special uses while specifying a single range of asphalt content, as 60 to 70 per cent. Maximum penetration can be secured by using oil of low viscosity. For mixed treatments, medium viscosity appears desirable, because the oils with high viscosity are harder to handle and more difficult to mix with road metal. In surface-treatment work where chips are to be used in quantity, high viscosity is desirable.

Probable rainfall is another consideration affecting the selection of oil. The lightest oil shows a tendency to wash out of the road during long-continued wet weather. In many instances good results have been secured by applying light oil as a first treatment, followed, after this treatment has penetrated, by an application of heavy oil and screenings. In all of these matters viscosity is an important characteristic.

All of the grades of "fuel oil" used in bituminous treatment are more uniformly distributed if heated to 150° F. or 200° F. The oil is usually heated with steam at the time it is unloaded from the car.



TAKEN ON PACIFIC HIGHWAY ONE MONTH AFTER COMPLETION OF SURFACE, SHOWING SURFACE TEXTURE WHICH WAS RETAINED UNDER HEAVY TRAFFIC

Keeping Rhode Island Roads Open in Winter

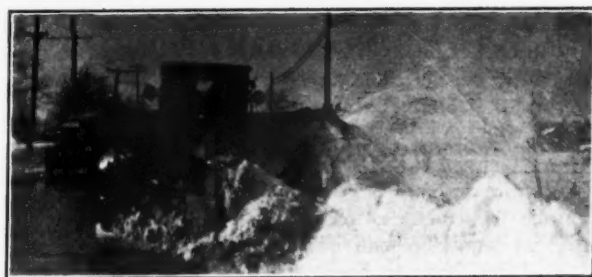
Equipment and methods employed by Board of Public Roads in keeping all highways open to traffic.

By David D. Bouchard

It was not until the winter of 1922-23 that the Rhode Island State Board of Public Roads undertook the task of removing snow from the country highways. Prior to then the responsibility rested solely with the towns. The futility of continuing under that system was revealed during the winter of 1919-20, when for days the roads were impassable because of inability of local forces to clear away a deep blanket of snow laid by numerous successive storms. With motor transportation crippled, business suffered and so numerous and indignant were complaints that the State was forced to make a special appropriation of \$50,000 to break open the highways. The next session of the General Assembly witnessed the passage of legislation that placed the work of clearing the roads in the hands of the Board of Public Roads.

When the board first took over the work it was without adequate equipment and lacked practical experience. Today its machinery for combating snow storms consists of 52 trucks equipped with straight blades; three 1½-ton tractors and one 3-ton tractor, all with V-plows; and nine 5-ton tractors with rotary plows. At the outset it was thought advisable to equip for the average storm only. Later, however, as traffic increased and the highways became recognized as a vital factor in the commerce of the State, the department added to its machinery until now it can handle with comparative ease even the heaviest of storms.

One of the first problems which the board was forced to solve was that of building up an organization of snow fighters that could be mobilized and set in action without loss of time. The experience when the board was drafted suddenly into snow removal service in 1920 showed conclusively the necessity of having trained men and adequate equipment ready at all times. It also showed that preliminary preparation played no small part in the success of the undertaking.



ROTARY SNOW PLOW WORKING ON A RHODE ISLAND ROAD

liminary preparation played no small part in the success of the undertaking.

The board came to the conclusion that to depend on gangs of temporarily unemployed men at each snow fall might be an excellent way in which to dispense charity but not to build up an efficient force, and it turned to its regular maintenance crew for the solution. Since there are many features of highway maintenance that can be carried on to advantage in the winter, the board decided that to retain a majority of the summer workers would not only furnish a trained snow removal force but would also tend to minimize the cost of maintaining and clearing the highways. The cost of mobilizing men and equipment and planning for operation is necessarily high, even though there be little snow fall, but when the work of removing deep snow is combined with highway maintenance it has been found that the expense can be cut considerably. With a year-round crew the department now not only can combat snow storms but also finds it much easier to keep abreast with its ever imperative maintenance work.

PROCEDURE

A pre-determined plan of procedure also forms an important phase of Rhode Island's system. Long before the cold weather makes its appearance preparations for clearing snow are under way. All plows are taken out of storage, overhauled and made ready for use. Since storm statistics kept by the board show that the heaviest snow falls occur in the northern part of the State, the most powerful equipment is moved to stations in that section in anticipation of the coming snow. Other machinery is distributed according to the needs of each locality. Since the plow blades interfere with the trucks in their maintenance work, the plows are not attached until just before the truck begins its snow removal work. The blades are carefully fitted, however, so that no time is lost in getting the vehicle into action.

The success of the plan is based on the ability of the organization to keep ahead of the storm rather than to clear the snow away after it has fallen. Forewarned by government bulletins and local weather observers of the approach of a storm and its probable severity, an opportunity is afforded to mobilize the men and get the equipment in readiness before the snow begins to fall.

When two inches of snow has fallen the trucks begin plowing. As the crews are permanent, the work is greatly facilitated. Each truck crew knows just the portion of road for which it is responsible,



OPENING A ROAD IN NORTHERN RHODE ISLAND
Prior to purchase of rotary plows, this "Big Boy" was the pride of the department

confusion is eliminated and the work is carried on with a precision and thoroughness attained only through constant repetition and experience. The spirit of trained, regular crews is remarkable. The men take pride in their work, feel deeply their responsibility to keep the roads open, and willingly work many extra hours at their regular hourly wage. Largely because of the ability and spirit of the men, Rhode Island boasts that its highways are never closed because of snow, even for a few hours, in the worst of storms.

Speed is essential to effective snow removal. Half an hour lost during a storm may delay the opening of the roads for hours. The crews' sections are made short to insure that the highways will be plowed frequently and to diminish the possibility of deep drifts. Provisions are made also for emergencies, such as the breaking down of equipment or the sickness of operators.

In spite of this, however, unforeseen difficulties arise to retard the work. In storms when the wind velocity is great, trees and poles are blown across the highways. Sometimes these can be removed with little or no delay, but on other occasions, particularly when live wires are brought down with poles, the road is blocked until expert linesmen can be hurried to the scene and repair the damage. Another handicap is created by motorists who stall their vehicles in attempting to pass other cars by driving through the deep snow piled along the side of the road, forcing the workmen to dig them out before continuing.

The necessity of pushing back the ridges of snow left by the plows was brought home forcefully to the local department in the winter of 1922-23 when several storms occurred at short intervals. Had it not been the practice of the department immediately to throw back snow from the side of the road, it is probable the width of the cleared pavement gradually would have become so narrow as to constitute a menace to traffic.

Considerable attention is paid to the work of keeping culverts open to allow proper drainage; otherwise the melted snow would freeze on the road surface and make it slippery and dangerous. Cutting down trees, mowing tall grass and constructing snow fences as a means of preventing drifting is a detail of importance in the Rhode Island system. Stakes placed along the roadway to guide the workers in deep snow also are of great value.

Last year the cost of removing snow from the 451 miles of State-maintained highways was slightly more than \$31,000. This figure was for gasoline, oil and labor only and did not include the depreciation of equipment. It is estimated that the cost would have been doubled if the rate per hour of trucks and equipment used was added. The board feels, however, that the benefits accruing from snow removal exceed by many times the cost, and that unless the work is properly done and the highways are kept open at all times much of the return on the State's expenditure for highways is lost.

The larger cities and towns also believe that no cost for effective snow removal is prohibitive, and have equipped themselves to meet almost every con-

tingency. Consequently, virtually every highway in the State is kept open at all times, and even the most remote roads in the back country are now available to traffic within 48 hours after the average snow storm.

Henry M. Pickersgill, head of the snow removal department, who furnished the above information, states that the Rhode Island system differs radically from those employed in either Massachusetts or New York State in that the work in Rhode Island is done solely under State supervision, and with uniform equipment; whereas in the other States mentioned the towns and cities are responsible for removing snow from State highways, and the effectiveness of the system and equipment varies with the size and wealth of the particular municipality or township charged with the work.

The matter of employing regular maintenance crews throughout the year for repairing highways and removing snow is probably further developed in Rhode Island than in most other States. So also is the work of building snow fences, etc. Preventive measures in Rhode Island's system receive almost as much attention as the actual snow removal work itself.

Recent Developments in Sewage Chlorination*

Effects and advantages, determination of amount required, and point of application to secure best results.

It has been very definitely shown that one cannot, with any degree of certainty, rely upon a fixed dosage of chlorine to produce effective disinfection continuously. Not only does the quantity of chlorine required differ for different sewages, but for the same sewage the requirements will vary as much as 100 per cent during a cycle of twelve months. The simplest and most satisfactory method of determining with certainty that the dosage of chlorine is correct is the application of the orthotolidine test. The presence of residual chlorine after a ten-minute contact period between the chlorine and sewage is indicative of efficient disinfection.

The quantity of chlorine required for disinfection is influenced by the *soluble* organic and oxidizable inorganic matter in the sewage. As the oxygen demand of the sewage increases, the chlorine demand likewise increases. The chlorine demand of the sewage must be satisfied before the slight excess, or residual chlorine, becomes available to destroy the pathogenic organisms. It is evident that chlorine demand and biochemical oxygen demand are very closely related characteristics of sewage.

C. E. Keefer published data relative to the Baltimore disposal plant, showing a marked increase of the biochemical oxygen demand value of the sewage in summer as compared with winter; while W. D. Tiedeman, after a 15-month study of chlorinating Imhoff tank effluent at Huntington, Long

*From a paper presented at the Texas Water Works School, by L. H. Enslow, sanitary engineer with the Chlorine Institute.

Island, found that the chlorine demand of sewage varies greatly between winter and summer. Reduced biological activities with the advent of cold weather allow a greater quantity of the suspended solids to remain as such without becoming colloidized in the sewer proper. As a result of this, the biochemical oxygen demand and the chlorine demand both drop, only to increase again with the return of warm weather and renewed biological activity in the sewers and settling tanks. The two curves paralleled each other to a marked degree. Tiedeman's figures show a maximum chlorine demand of 12.5 parts per million in July and a minimum demand of 6.5 parts in February.

Apparently the State Department of Health of New Jersey was the first to realize (in 1925) that the application of a constant dosage of chlorine to certain sewage effluents failed to produce continuously satisfactory disinfection. But it was not until 1925-1926 that it was shown definitely, by Tiedeman, how greatly the chlorine demand actually varies during the year. His investigation showed the relative unimportance of providing contact periods in excess of 10 minutes. Even less time of contact is required in the case of efficiently clarified effluents, if residual chlorine is found to the extent of 0.5 p. p. m. in the sewage sample held for 10 minutes after the chlorine application before the test is applied. Data collected in Dallas, in 1926 by O. M. Bakke and Edgar Whedbee show that reduction of 37-degree bacteria from 5,000,000 or more per c.c. to 1,000 and less per c.c. was accomplished within 5 minutes whenever residual chlorine was present. If no residual chlorine is indicated by the orthotolidine test, but there is sufficient to produce a distinct positive test with the starch-iodide test in the presence of acid, the efficiency after 60 to 90 minutes will be greater than that after ten minutes. With the appearance of the slight yellow color indicative of residual chlorine by the orthotolidine test, the killing of 95.5 per cent or more of the total bacteria and *B. coli* is almost instantaneous. In practically every case where 0.2 to 0.5 p. p. m. of residual chlorine was found, the disinfection was satisfactory in less than five minutes after the application of chlorine. Rapid, spontaneous mixing of chlorine and sewage is of far greater importance than the period of contact.

Our knowledge that a ten-minute contact is sufficiently long may permit using contact chambers of extremely small dimensions; or "prechlorination" of sewage may result in the complete elimination of special contact chambers.

Tiedeman's study also indicated that, in the presence of residual chlorine, the efficiency of the killing of bacteria within the settleable solids in the effluent was practically as great as that obtained in the watery portion. The most painstaking work seemed to indicate effective penetration of the solids by the chlorine.

PRECHLORINATION OF SEWAGE.

Two of the greatest obstacles in the way of economically effective chlorination are septicity of the sewage and, even more important, its hydrogen sulphide content. Of less importance is the presence of ferrous iron compounds. Septicity is of much more importance in the presence of sulphates than

otherwise, the sulphates being broken down by the bacteria in sewage to form hydrogen sulphide. At Marlin, Texas, domestic sewage fresh from the sewer showed a chlorine demand of 5.5 p. p. m.; but further down, after it had received a flow of well water of high sulphate content, the chlorine demand increased to 12 p. p. m.; and after the mixture of sewage and sulphate water had passed through an inverted siphon, the chlorine demand varied from a minimum of 15 to a maximum of 35 parts. The effluent from the Imhoff tank which received this sewage showed a demand ranging between 35 parts and 90 parts. At Dallas, the chlorine demand of the crude sewage was from 30 to 75 per cent less than that of the tank effluent. At Fort Worth, where no odors of the hydrogen sulphide are in evidence and it is known that the crude sewage contains only a small quantity of sulphate in solution, there is practically no difference in the chlorine demand of the crude sewage and the Imhoff effluent.

From these and other studies it has become evident that it is advisable to recommend prechlorination of sewage as a means of reducing chlorine consumption. Advantages of prechlorination are: Greater chlorine economy; the flow chamber is maintained in a fresher condition; reduction, if not elimination, of odors in the effluent; the necessity of providing chlorine contact chambers beyond the tank is eliminated; the oxygen demand of the effluent is reduced; the "balance wheel" effect secured by the flow chamber of the tank, which acts as a large contact chamber, is also a distinct advantage in smoothing out the fluctuations; finely divided or flocculent solids leaving the tank in the effluent are effectively penetrated and disinfected when residual chlorine is maintained in the influent end of the tank, not necessarily in the effluent; and Imhoff tank foaming appears to have been controlled at certain plants through prechlorination.

Observations at Schenectady and Marlin appear to show a tendency toward precipitation of flocculent masses from the sewage as a result of prechlorination. During the summer of 1926 at Cleveland, Ohio, at the easterly plant crude sewage was chlorinated and at the westerly plant Imhoff tank effluent was chlorinated. The former sewage is relatively fresh, whereas the westerly tank effluent is impregnated with packing wastes, sulphate of iron and other industrial wastes, and is also septic and odoriferous during warm weather. Here prechlorination is for the protection of bathing beaches only and is discontinued in the winter time. Last summer the westerly effluent was dosed with 8.9 p. p. m. and the easterly crude sewage with 8.2 p. p. m. In the former there was no residual chlorine found at any time, while in the latter it could be maintained to the extent of 0.2 p. p. m. or more. Contrary to the usually accepted idea, the crude sewage containing the solids underwent a greater bacterial reduction than that obtained in the case of the westerly tank effluent receiving practically the same chlorine dosage. In the case of the chlorinated crude sewage, the total reduction of bacteria from June to September averaged 96.33 per cent as compared to 79.4 per cent in the Imhoff effluent, and the reduction of *B. coli* was 94.5 and 84.6 per cent respectively.

Preliminary studies at Fort Worth indicate that a small dose of chlorine, about one-third that necessary to satisfy the chlorine demand, is all that is necessary to stay hydrolysis and septic action in a highly organic and putrefiable substance, such as packing house wastes. It is highly probable that a relatively small dosage of chlorine, if applied to the sewers direct at a point some distance ahead of the disposal plant, may serve to retard materially the progress of biological activity in the sewers. Such sewage when reaching the plant would be more like fresh sewage, the solids be less in solution and more of them in settleable condition; the oxygen demand less and the quantity of chlorine required materially less. Also it is probable that the biochemical oxygen demand value may be kept in the solid phase, which the settling process may remove, and thus insure a tank effluent of less oxygen demand than otherwise. Also the production of hydrogen sulphide, which is so destructive to sewers, should be retarded if not actually prevented. These results of early chlorination may not only reduce the total amount of chlorine required but may even remove the necessity of any chlorination in the plant. This matter seems of sufficient importance to demand further study, and the Chlorine Institute has established a fellowship at Rutgers University where chlorination studies will be conducted under Dr. Rudolfs; while in California experiments under the supervision of the State Department of Health were expected to be under way to determine the benefit of applying chlorine to long trunk sewers and outfalls.

ODOR CONTROL.

The practicability of reducing and ultimately eliminating odors from sprinkling filters has been demonstrated at Schenectady, New York; Marlin, Texas and elsewhere. At Schenectady, 4 p. p. m. satisfactorily reduced the odors; at Marlin, the sulphide content was so great that the quantity of chlorine required proved prohibitive, varying between 15 and 35 p. p. m. at the inlet of the Imhoff tank; at Portsmouth, Ohio, highly efficient disinfection and odor elimination were secured by but 10 p. p. m. of chlorine. The amounts have varied as widely as the sewage which created the odor. The quantity of chlorine required depends primarily upon the quantity of hydrogen sulphide in the sewage before it reaches the plant. It would seem more logical to retard or prevent hydrogen sulphide production in the sewers or tanks than to attempt to destroy it later.

REDUCING FLY NUISANCE AND FILTER CLOGGING.

At Schenectady, M. M. Cohn controlled the breeding of the psychoda or filter fly, which breeds in the upper stone layers of sprinkling filters, by applying sewage containing 3 to 5 p. p. m. of residual chlorine, which caused the film around the surface stone to loosen and wash out of the filter, carrying with it the eggs and larvae of the fly. The treatment here called for approximately 25 p. p. m. of chlorine applied at intervals of 14 days, the first treatment continuing for 48 hours and subsequent treatments for one night only; night flow being used because, being usually of less volume, it required less chlorine. Removing the film also relieves the pooling ten-

dency. Also the pipe lines from the siphon and the nozzles are cleaned of the filamentous growths which are responsible for head loss and nozzle clogging.

REDUCTION OF BIOCHEMICAL OXYGEN DEMAND.

It appears fairly certain that the action of chlorine on putrescible organic matter of certain classes so alters its composition as to render it nonputrescible. The reason for this is not immediately apparent. The reduction in demand appears to be a permanent one, for chlorinated sewage which was subsequently inoculated with sewage bacteria failed to exhibit the oxygen demand which it had prior to chlorination. Figures illustrating this action were given for Dallas; Schenectady; Huntington, Long Island; and other places. At Dallas, reduction effected with dosages sufficient to produce residual fell within a range of 45 to 62 per cent, equivalent to 80 parts per million and 200 parts per million respectively. At Schenectady, Cohn observed oxygen demand reduction when applying from 4 to 6 p. p. m. to crude sewage entering the tanks, although this was only about half that which would have been required to insure residual chlorine. Gaunt and Abbott suggest that ordinarily unchlorinated effluent would require dilution by the receiving body of water in a proportion of 30 volumes to 1, while the same effluent treated with 2 p. p. m. of chlorine should require but 18 volumes of dilution.

The poorer the quality of activated sludge effluent or other effluent, the more valuable becomes the effect of chlorination; also the less the volume of dilution water or the poorer the condition of such water, the greater should be the effect of chlorination. It is therefore suggested that chlorination might be used at certain seasons when the plant performance is at low efficiency or the receiving stream is deficient in flow or in quality; and that in some cases tank treatment plus chlorination may be all that will be required for many years.

POINTS OF CHLORINE APPLICATION.

As already stated, where only tank treatment is given, chlorine should be applied to the influent of the settling tank, whether for the purpose of disinfection, odor control, or improvements in the other functions of the tank, such as foaming. Where secondary tanks follow sprinkling filters, the chlorine should be applied to the filter effluent rather than to the tank effluent. A full discussion of this was given in *PUBLIC WORKS*, for July, 1927, by W. S. Mahlie based on experience at Fort Worth. Experience at the activated sludge plant at San Marcos, Texas, indicates that better plant efficiency might result from having two sets of sludge settling tanks, the returned sludge being drawn from the primary, the secondary receiving the lighter and less thoroughly activated effluent which is first chlorinated. This experience indicated that sludge deposited from chlorinated effluent does not require prompt or continuous removal in order to avoid fermentation and bulking.

Where the aim is odor control and the delay of septic action, sufficient data have not been collected to permit publishing a definite statement, but it seems probable that the most appropriate point of chlorine application to prevent odor nuisances, hydro-

gen sulphide production, destruction of mains and hydrolysis of sewage solids is to apply it in the trunk sewers.

Mr. Enslow briefly considers chlorination of effluents from fine mechanical screens, concerning which little is known; and the use of chlorine for reducing foaming of Imhoff tanks, citing the experiment at Lufkin, Texas, where 3 parts to 20 parts of chlorine caused subsidence of foaming, which recommenced when chlorine was discontinued. He also referred to experiments with chlorinated copper as for conditioning activated sludge.

In estimating the cost of sewage chlorination, the author refers to the experiment by Tiedeman at Huntington, Long Island. The New York State Department of Health had required a dosage of 15 p. p. m. of chlorine because it had been found at other plants that at times a smaller dosage resulted in poor disinfection. Using the orthotolidine test to always insure .5 part to 1 part residual chlorine, it was found possible to greatly reduce the dose, the average chlorine consumption for the entire 12 months being only 9.6 p. p. m. when the rate was fixed for each day on the basis of the quantity required to produce residual at the time of maximum chlorine demand and flow. When the chlorine rate was changed at 8 A. M. and 4 P. M. based on the maximum flow and chlorine demand for the day and night flows respectively, the amount required could be reduced to about 6.5 parts. On the basis of 7.5c. per pound, the 15 parts originally demanded would cost \$14.44 per million gallons, which would be reduced to \$9.23 if the chlorine rate be fixed each day, and to \$6.59 if it be fixed twice a day; and finally to \$4.38 per million gallons if changed hourly to maintain 0.5 to 1 p. p. m. residual continuously.

Ancient Tunnel Surveying

It has generally been assumed (and correctly, so far as we know) that there has not existed for more than say 150 years any appliance even approximating the present surveyors' transits for making precise surveys or laying out straight lines or angles. It is therefore a source of wonder how the ancients carried out some of the works which we find still existing as irrefutable testimony that they were actually constructed. For instance, without levelling instruments, how were aqueducts carried across hills and valleys for miles with a uniform gradient throughout?

Another remarkable instance is referred to in a description of the water supply of Jerusalem read recently by S. R. Raffety before the Royal Sanitary Institute Congress. Near Jerusalem is the Virgin's spring and the pool of Siloam. A tunnel about 1,100 feet long connects the two, which is supposed to be the work of Hezekiah who, according to the Second Book of Kings, chapter 20, "made a pool and a conduit and brought water into the city."

"It is interesting to note," says Mr. Raffety, "that the ancients must have had considerable knowledge of maintaining direction under ground, as an inscription on the wall shows that the tunnel was driven from either end and records that "When yet there were three cubits (about 2 feet) to be bored, heard was the voice of each calling to his fellow—the hewers struck each to meet his fellow, pick against pick; then went the waters from the issue

to the pool for two hundred and a thousand cubits, and a hundred cubits (66 feet) was the height of the rock above the hewers."

Eleven hundred feet is, of course, not now considered a long tunnel and it is not stated by how many inches or even feet the center lines failed to meet; but it is rather remarkable that, without the use of transits or similar instruments of precision, it was possible to bring the two headings together at all through a tunnel of this length.

Merchantville-Pensauken Sewage Treatment Plant*

Discussion of samples taken; the effect of inoculation and of removing sludge; heat and fertilizer values of sludge; causes of good operation.

By Major Michael J. Blew

The first set of samples was taken on February 22, 1926, in the presence of M. B. Tark and R. Case the operator. The results were so remarkable that the samples were shown at the 1926 meeting of the New Jersey Sewage Works Association. Other samples were collected on April 8th, two sets April 26th, June 17th, Nov. 12th, Dec. 14th and Dec. 28th 1926, Jan. 13th, Feb. 1, March 8th, 9th, and 10th May 2nd, 3rd, and 10th, and August 2nd, 1927. Many other samples were taken at different times, for various purposes, but the above dates represent complete samples from the sludge tank.

The sample of fresh sludge was taken from the pump sump before being pumped to the digestion tank. It was number 1 of the series of samples. All the others were collected from manholes, in order, and numbered from 2 to 10 inclusive. These samples were taken at a depth of 6 feet, which is near the mid-depth of the tank. Sample No. 11 was taken directly from the sand beds after drying.

Another series of samples was collected to determine whether a given section of the tank was of uniform composition throughout its vertical area. The samples were collected by means of a self-closing bottle, which insured the collection of a sample representative of the material at the depth desired. It was found that the scum layer was probably a

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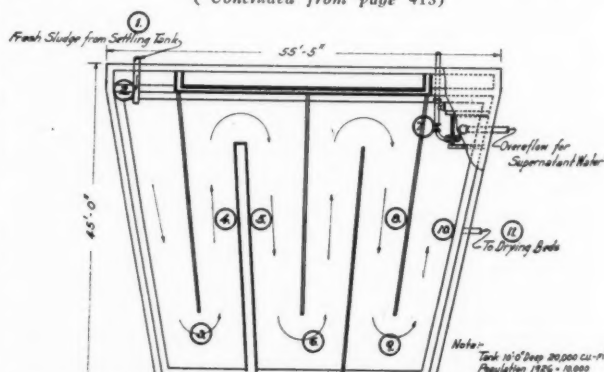


FIG. 3.—PLAN OF SLUDGE DIGESTION TANK. NUMBERS INDICATE POINTS AT WHICH WERE TAKEN SAMPLES REFERRED TO IN THIS ARTICLE.

Table No. 1—Record of Plant Operation

Date	Average Daily Sewage Flow	Settleable Inffluent	Solids Effluent	Cu. Feet C.C. per Litre % Removed	Feet Screenings Removed	Total Time Pumps Operated in Hours	Air Monthly Mean	Temperature Sewage	Total cu. yds. Fresh Sludge Pumped from Settling Tank	Total cu. yds. Digested Sludge Drawn to Sand Beds
1926										
July	887,000	7.8	.10	98.7	62	51	76		52	43
August	977,800	7.1	.09	98.7	62	60	75		61	0
September	1,026,700	7.2	.09	98.7	72	48½	68		70	0
October	895,000	9.0	.10	98.9	68	48	57		43	145
November	988,400	7.6	.08	98.9	65	33	46		54	0
December	903,300	6.8	.10	98.5	73	42	32		74	45
1927										
January	803,000	5.7	.08	98.6	91	42	33	45+	68	0
February	546,000	5.4	.07	98.7	84	48	41	46+	68	51
March	889,000	4.7	.07	98.5	93	19	46+	47+	73	34
April	783,000	4.9	.08	98.4	72	26	51+	49+	53	41
May	839,000	4.3	.08	98.1	62	69	63	56+	61	42
June	764,000	4.4	.08	98.2	60	38	69	61+	92	73
July	754,000	4.2	.07	98.3	62	66	76	67+	83	23
August	882,000	4.4	.08	98.2	69	40	70	69+	90	48
Total	11,938,200				995	630			942	545
Average for 14 Months	852,700	6.0	.08	98.7	71	45			67.3	39

First 11 samples composited. 12th sample, beginning of run; 13th sample, end of run and composited. Last 2 composited.

Table No. 2—Data on Digesting Sludge

Date	Sampling Stations	%H ₂ O	%V.M.	%Ash	B.O.D. p.p.m.	pH	%P ₂ O ₅	%Total NH ₃	B.T.U. per lb. Dry Wt.	%Ether Soluble Matter
Feb. 22, 1926	1	91.7	61.3	38.7	1,400	6.0	2.4	2.69	6,508	31.1
" " "	3	86.4	51.3	48.7		6.9	1.6	2.25		21.8
" " "	4	86.2	48.7	51.3	900	6.9	1.3	2.41		18.3
" " "	5	88.2	46.9	53.1		7.1	1.5	2.69		
" " "	6	91.1	47.8	52.2	650	7.4	1.6	2.72		14.8
" " "	8	91.1	46.1	53.9		7.6	1.6	2.19		
" " "	9	84.3	39.1	50.9		7.6	1.8	2.29		10.4
" " "	10	89.0	45.1	54.9	350	7.6	1.8	2.82	6,799	10.0
June 17, 1926	1	94.9	70.0	30.0	125,000	5.8	2.4	3.33		27.3
" " "	2	92.3	61.6	38.4		5.6	1.6	2.75		
" " "	3	85.8	42.3	57.7		6.9	1.3	2.26		
" " "	4	89.2	50.0	50.0		7.0	1.5	2.55		
" " "	5	88.1	48.5	51.5		7.3	1.6	2.62		
" " "	6	88.6	53.2	46.8		7.4	1.6	2.89		17.2
" " "	7	84.3	37.8	62.2		7.6	3.0	2.34		
" " "	8	90.2	44.4	55.6		7.6	1.8	2.62		
" " "	9	91.7	41.2	58.8		7.6	1.8	2.54		
" " "	10	90.1	43.8	56.2	10,600	7.6	2.5	2.65		11.0
Nov. 12, 1926	1	94.2	66.7	33.3	60,500	5.2		3.40	7,484	28.7
" " "	4	86.5	50.0	50.0				2.98	5,592	17.3
" " "	6	88.9	42.9	57.1				2.95		12.1
" " "	9	88.1	38.6	61.4		8.0	2.0	2.95		8.0
" " "	10	89.5	34.3	65.7	15,900			3.22	4,044	8.4
April 8, 1926	4	77.8	73.1	26.9		7.1		3.90		
" " "	4	88.3	55.2	44.8		7.0		2.54		
" " "	4	87.8	58.2	41.8		6.9		2.90		
" " "	4	86.8	54.9	45.1		6.9		2.30		

Samples taken at depth of 6 ft., except those taken April 8th, of which the 1st was scum, the 2nd 3 ft. deep, the 3rd 6 ft. deep, and the 4th 9 ft. deep. The series of June 17th was taken after inoculation with digested sludge. Of those taken Nov. 12th, the first had K₂O = .06% and fourth K₂O = .04%.

Table No. 3—Physical Characteristics of Sludge Following Digestion

Date	Sampling Stations	Odor	Color	Gas Formation	Nature	Consistency
Feb. 22, 1926	1	Very Foul	Light Gray	None	Dead & Heavy	Gelatinous & Slimy
" " "	3	Foul & Undigested	Dark Gray	Very little	Dead & Heavy	Gelatinous & Slimy
" " "	4	Foul & Undigested	Dark Gray	Little Gas	Dead & Heavy	Gelatinous & Slimy
" " "	5	Semi-digested	Black Gray	More than No. 4	Little Life	Gelatinous & Semi-slimy
" " "	6	Faint Tarry Odor	Black Gray	Profuse Gas	A Little Life	Gaseous & Semi-slimy
" " "	8	Tarry Odor	Grayish Black	Profuse Gas	Light & Active	Granular & Fluffy
" " "	9	Tarry Odor	Jet Black	Profuse Gas	Light & Active	Granular & Fluffy
" " "	10	Tarry Odor	Jet Black	Profuse Gas	Light & Active	Granular & Fluffy
June 17, 1926	1	Very Foul & Sour	Light Gray	None	Dead & Heavy	Gelatinous & Slimy
" " "	2	Foul & Sour	Dark Gray	Very little	Dead & Heavy	Gelatinous & Slimy
" " "	3	Earthy & Foul	Black Gray			
" " "	4	Foul & Faint Tarry	Grayish Black	More than No. 2	Little Active	Gelatinous & Semi-slimy
" " "	5	Pronounced Tarry	Black	Profuse Gas	Very Active	Semi-gelatinous & Semi-granular
" " "	6	Pronounced Tarry	Jet Black	Profuse Gas	Very Active	More Granular
" " "	7	Pronounced Tarry	Jet Black	Profuse Gas	Very Active	Granular
" " "	8	Pronounced Tarry	Jet Black	Profuse Gas	Very Active	Granular
" " "	9	Pronounced Tarry	Jet Black	Profuse Gas	Very Active	Granular
" " "	10	Pronounced Tarry	Jet Black	Profuse Gas	Very Active	Granular
Nov. 12, 1926	1	Very Foul	Dark Gray	None	Dead & Heavy	Gelatinous, Slimy & Stringy
" " "	4	Faint Tarry Odor	Black	Little Gas	Active	Semi-granular
" " "	6	Digested Tarry Odor	Black	Profuse Gas	Very Active	Granular
" " "	9	Strong Tarry Odor	Jet Black	Profuse Gas	Very Active	Granular
" " "	10	Strong Tarry Odor	Jet Black	Profuse Gas	Very Active	Granular
April 8, 1926	4-Scum	Faint Tarry Odor	Black	Profuse Gas	Active	Fibrous & Stringy
" " "	4-3 ft.	Sour, Foul & Undigested	Grayish Black	Little Gas	A Little Life	Gelatinous & Slimy
" " "	4-6 ft.	Sour, Foul & Undigested	Grayish Black	Little Gas	A Little Life	Gelatinous & Slimy
" " "	4-9 ft.	Sour, Foul & Undigested	Grayish Black	Little Gas	A Little Life	Gelatinous & Slimy

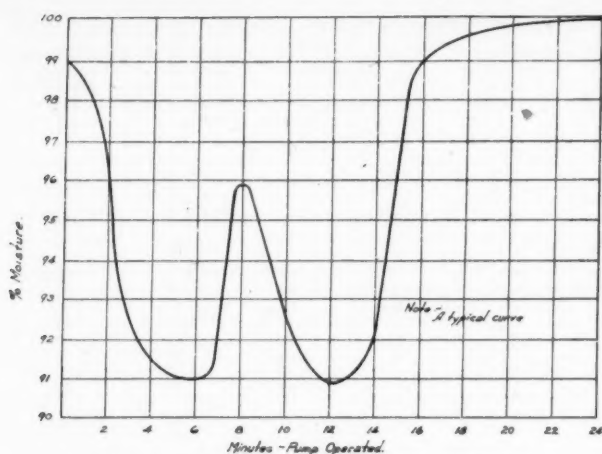


FIG. 10—DENSITY OF SLUDGE PUMPED

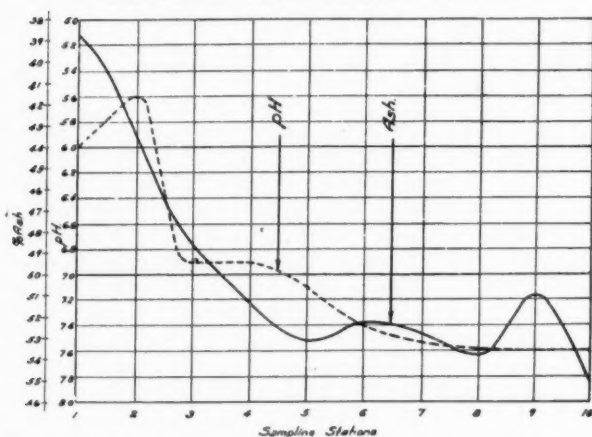


FIG. 11—PROGRESS OF DIGESTION, FEBRUARY, 1926

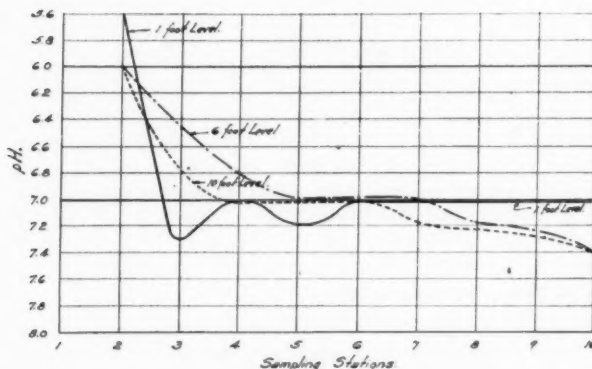


FIG. 12—PH AT VARIOUS LEVELS IN SLUDGE TANK, AUGUST, 1927

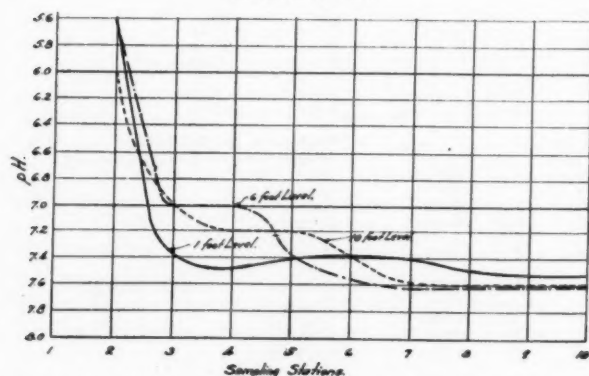


FIG. 13—PH AT VARIOUS LEVELS IN SLUDGE TANK, AUGUST, 1927

little more completely digested, but that otherwise the samples were practically uniform. It is therefore believed that our sampling point of six feet was well selected and that the results are comparable. Two curves (Figs. 12 and 13) are shown for illustration, one taken in March 1927, immediately following winter conditions, and a second taken August 1927, after a summer of inoculation with seeded sludge. The March curve shows more rapid digestion (from the pH) in the scum samples, and a little lag in the 6 and 10-foot samples. All samples after station five were well digested and the August samples distinctly show the effect of inoculation on sludge digestion. In this case all three sludge level samples indicate thorough digestion after the third station.

At a few points in the tank there are apparently pockets where digested sludge is retained. This condition can largely be obviated by creating a baffled tank with a uniform cross-section, through which the digesting sludge must flow. If short circuiting occurs, it can occur only at corners where the cross section of sludge flow is radically increased. This fact was borne out in the tests made.

Only a few of the results are given here, but typical cases have been selected for the purpose of illustrating what takes place in the digestion tank. All of the samples tend to demonstrate identical facts. One of the best series of samples was the very first one collected on Feb. 22, 1926. (See Fig. 11.) The ash in the fresh sludge was 38.7%, which increased to 48.7% at the third sampling station; 53.1% at the fifth station, and around 54.9% at the tenth station. The increase in ash content was relatively constant throughout the entire length of flow.

The pH started at 6.0 with fresh sludge and dropped to 5.6 at the second sampling station. It then rose rapidly to 6.9 at station three, gradually increasing to 7.4 at station six, and to 7.6 at the last station.

The initial lag in pH is probably due to the rapid decomposition of soluble and semi-soluble carbohydrates in the sludge, by bacteria of the acid-forming type. Real nitrogenous digestion does not begin until this initial phase is practically over. Decomposition of nitrogenous material is accompanied, among other things, by the liberation of ammonia, which has a tendency to produce an alkaline medium. This increase in alkalinity is accompanied by a corresponding decrease in the acid-forming types and an increase in alkali-producing types of bacteria. Ordinarily this nitrogenous decomposition takes place most rapidly between the second and fifth sampling points.

The third phase is the decomposition of cellulose and allied carbohydrates. In this phase, much methane appears in the gas, and the gassing of sludge is most vigorous. This takes place near the 6th, 7th, and 8th sampling stations.

These results are gratifying, inasmuch as they follow the same general tendency often found in bottle experiments in the laboratory; with the particular difficulty, in this case, of collecting samples from an operating tank to demonstrate the various phases of digestion.

Physical observations were made at the time these samples were taken, and an attempt made to put into words the changes seen to be taking place. It will be seen from Table 3 that the physical characteristics undergo a constant change from the original foul, sour, lifeless, gray and slimy mass, to the final jet black, granular and active sludge with the tarry odor, which answers the general concept of being well digested. The samples, dried and bottled, present a remarkable demonstration of the changes actually taking place in the digestion process.

These physical characteristics and the analyses follow the same trend throughout our studies. Manipulation of sludge only changed the relative location of the points of change in the tank.

Effect of Inoculation. Two curves are shown depicting clearly the effect of inoculation of fresh sewage solids with digested sludge. (Figs. 14 and 15.) These samples were collected May 2nd, 10th, 22nd, July 14th, 22, and August 2nd, 1927. The samples taken May 2nd were collected before any circulation of properly seeded material had taken place. Samples of May 10th followed the inoculation of fresh sludge with digested sludge supernatant. The samples of May 22nd, July 14th and 22nd, and August 2nd, show the increasing effect of circulation. Thirty-four cubic yards of sludge were drawn from the tank between July 14th and 22nd. The curves speak for themselves. On August 2nd, the sludge was practically all in a complete stage of digestion. In other words, by the circulation of digested sludge or supernatant, and feeding it with the raw material at the time of pumping, the digestion time has been reduced by more than 50%. Before inoculating with seeded material, the scum was thick and undigested at the earlier stations. After circulating digested sludge, the scum digested rapidly and then dropped from view at all stations except the first, second and third.

Effect of Removing Sludge. In April two sets of sludge samples were taken, one before and the other after drawing 900 cubic feet of digested material from the tank, to determine, if possible, what effect the process had on the sludge left in the tank. (Fig. 16.) This chart shows the ash and pH before and after drawing sludge. So much digested sludge was left in the tank that the results were not so marked as had been expected. The pH probably shows the effect of the more acid material moving along the tank to replace the sludge removed to the sand beds. The tank is tremendously over-size for the material it must handle, when the fresh material is properly seeded.

Biochemical Oxygen Demand. The biochemical oxygen demand fluctuates greatly, and the number of determinations made were insufficient to permit drawing intelligent conclusions. Analyses of a large number of B. O. D. determinations from the stations in a tank like this one should enable us to rate a sludge as to age, digestion, digestibility, etc. The reduction in B. O. D. during the progress of sludge through the tank amounted to about 75% in most cases.

Nitrogen. The figures for nitrogen fluctuate so

much, and depend so much on the sample and the manner of collection, that its determination is practically valueless as an indicator of sludge digestion.

Fats. The ether soluble matter showed considerable reduction between the influent and effluent of the digestion tank, generally amounting to about 65%.

Heat Value of Sludge. A decrease in heat value of about 50% accompanies the digestion of sludge. This is due largely to the decomposition of cellulose and the consequent liberation of methane and carbon-dioxide gas. The decrease in ether soluble

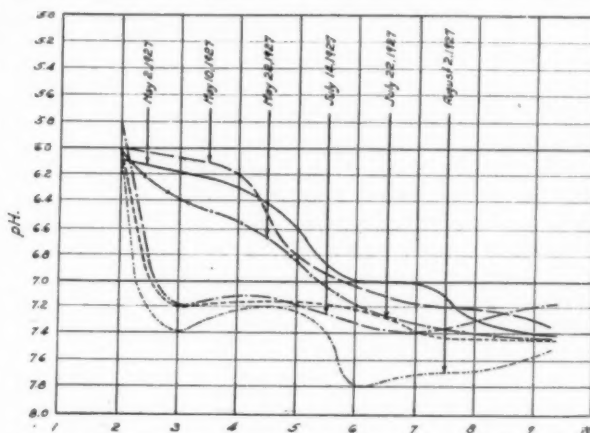


FIG. 14—EFFECT OF INOCULATION ON DIGESTION AS INDICATED BY pH

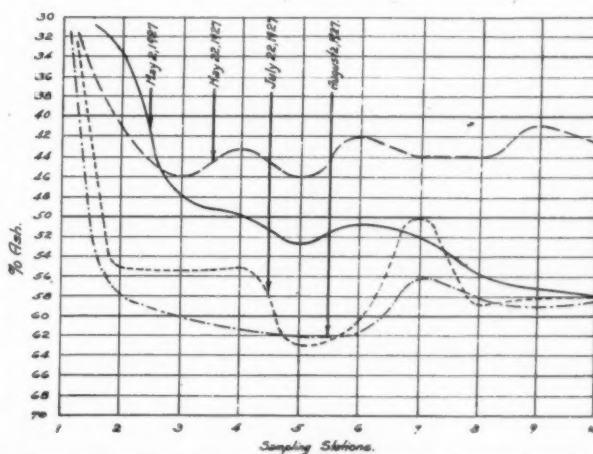


FIG. 15—EFFECT OF INOCULATION ON DIGESTION AS INDICATED BY ASH CONTENT

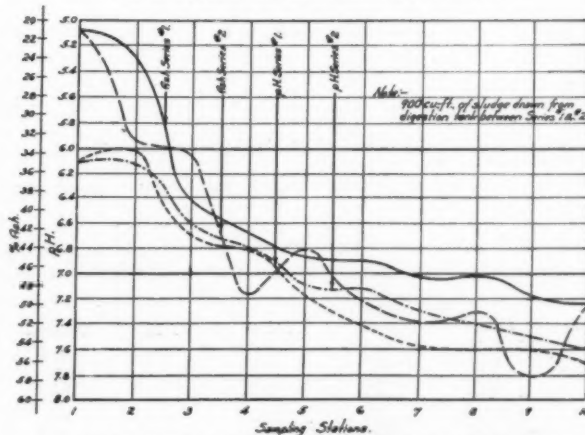


FIG. 16—CHANGES PRODUCED BY SLUDGE REMOVAL

Table No. 4—Bacteria in Sludge.
Per Gram Dry Solids.

Date	Sampling Stations	% H ₂ O	Aerobic				Anaerobic			
			Total	Red Colonies	Blue Colonies	B. coli	Total	Red Colonies	Blue Colonies	B. coli.
April 8, 1926	1	96	1,354,000	1,354,000		260,500	1,021,000	1,021,000		167,000
	2	85	98,900	82,400	16,500	16,500	82,400	82,400		11,800
	3	85	623,500	600,000	23,500	47,000	459,000	435,000	24,000	94,200
	4	88	1,091,000	1,023,000	68,000	68,200	431,000	431,000		79,500
	5	88	818,200	772,800	45,400	90,900	522,800	522,800		56,800
	6	89	404,500	393,500	11,000	67,500	350,000	337,100	12,900	56,200
	7	90	166,700	133,300	33,400		200,000	177,800	22,200	55,600
	9	83	168,700	144,600	24,100		337,400	313,250	24,150	36,150
	10	90	100,000	100,000		22,200	85,600	85,600		7,800
	4	88	2,500,000	1,250,000	1,250,000	681,800	909,100	784,100	125,000	45,500
April 26, 1926	6	90	435,500	177,800	255,700	111,100	211,000	188,900	22,200	
	3	90	77,800	33,400	44,400		66,700	66,700		22,200
	10	91	98,900	44,000	54,900	11,000	120,900	54,900	66,000	21,900
Nov. 12, 1926	4	88	681,800	568,200	113,600	340,900	500,000	454,500	45,500	204,500
	6	88	420,500	215,900	204,600	90,900	261,400	159,100	102,300	56,800
	8	84	107,200	59,600	47,600		178,600	131,000	47,600	95,250
	10	90	155,600	100,000	55,600	11,000	100,000	100,000		

matter also lowers the B.t.u. Fresh sludge has from 6,500 to 7,500 B.t.u. per pound of dry material.

Fertilizer Values. The sludge, both wet from the digestion tank and dry from the sand beds, has some value as a fertilizer. Total ammonia runs about 2.5%, making the material good for top dressing or for lightening a heavy soil; otherwise, it is valueless. The total phosphate is about 1.5% as phosphorus pentoxide; while potash is less than one-half percent. Dry sludge is used to spread on the grass and on flower beds.

Screenings. A number of samples of screenings were taken and examined completely. (Table 6.) This material is the most foul and objectionable that the sewage works operator must handle. At this plant it is buried, as the total quantity is very small. The percentage of cellulose is remarkably high, averaging about 40% for three samples examined. The B.t.u. were from 6,000 to 8,000 per pound dry weight, depending on the manner of collecting the sample. The screenings were dewatered from about 90% moisture to 68% moisture by means of a Laughlin Continuous Centrifuge, and it is believed that this machine may offer some decided advantages in the handling of screenings. Ordinarily, screenings dewatered to 65% will support combustion with little or no added fuel, and incineration is

Bacteria in Sludge. A number of bacterial examinations were made on lactose litmus agar in an effort to determine the relationship existing between the acid producing and alkali producing bacteria. Red colonies were predominant in fresh sludge, but they show a tendency to decrease with digestion, although they are always present in large quantities. On the other hand, blue colonies increase constantly with digestion, and are most abundant in the region of the most pronounced nitrogenous digestion. Typical B. coli forms decrease with digestion, probably from a decrease in their proper food supply and also from the production of an unfavorable alkaline condition in the sludge. These alkaline colonies on agar are being studied further.

CAUSES OF GOOD OPERATION

Some effort was made to determine why this sludge tank operates so well, while the former one behaved so badly. There are no factors particularly differentiating it from most separate digestion tanks, except the shape of tank and the method of circulating the sludge. Iron content has been suggested frequently as a cause of good sludge digestion and it has been claimed that the iron in the Merchantville-Pensauken sewage is excessively high, and that this is responsible for the behavior of the tank. A number of examinations have been made of the sewage tank effluent, swamp water, well water, and sludge tank supernatant, and also of sewage from other places; which show that the iron is not excessively high at any point about the Merchantville plant; in fact, it is much lower than in some other plants where the digestion is proceeding much less satisfactorily and where there are objectionable odors. Iron is normal in the sludge also. Furthermore, the sewage treated satisfactorily today by the Merchantville-Pensauken plant is at least similar to if not identical with the sewage which was treated by the previous plant a few years ago with a great deal of nuisance.

It is believed that the baffled sludge tank affords the best opportunity for controlling sludge digestion.

Table No. 5—Sludge Removed from Sand Beds.

Date	H ₂ O	Ash	B.T.U. per Pound		Fusion Point of Ash	Total NH ₃	P ₂ O ₅	Ether Soluble
			% Volatile Matter	% Dry Sludge				
Feb., 1926	42.3	53.9	46.1			2.70	1.20	14.1
March, 1927	49.2	67.2	32.8	4044	2020° F.	2.32	1.80	11.9
March, 1927	57.5	57.6	42.4					
March, 1927	63.8	48.2	51.8	3800	1998° F.	2.78	2.30	13.8
March, 1927	66.8	55.2	44.8			2.84		
Feb., 1927	51.3	40.3	59.7					
Feb., 1927	59.8	51.1	48.9					
Feb., 1927	49.3	51.9	48.1	5590	2040° F.	2.85	1.40	12.4
Feb., 1927	59.7	60.4	39.6					
Feb., 1927	60.4	53.2	46.8					

Ash from combustion was 98.8% fixed matter, showing almost complete combustion.

the only logical method of disposal from a sanitary viewpoint.

Table No. 6—Analyses of Screenings

No.	Date	Wet Basis		Percentage				Dry Basis		Cellulose	B.T.U.
		H ₂ O	Solids	Ash	Volatile	NH ₃	K ₂ O	P ₂ O ₅	Fats		
1	5-4-27	94.1	5.9	9.6	90.4	2.01		4.3	13.6	43.6	
2	5-5-27	92.7	7.3	11.1	88.9	1.84	.003	2.8	20.6	40.4	8172
3	5-9-27	91.1	8.9	17.1	82.9	2.32	.015		35.2		
4	5-12-27	89.9	10.1	14.5	85.5	1.94	.034	2.2	17.2	40.2	7656
5	5-14-27	87.4	12.6	8.9	91.1	1.78	.003	2.3	18.8		
6	5-31-27	89.8	10.2	13.1	86.9	2.34	.032	6.3	14.5		5878

Note:—Screenings collected and drained without pressing.

If dosing must be resorted to, it can be done more easily in this type of tank. Also seeding can be done readily and the digestion time considerably decreased. This type of tank could easily be heated and the time required for the digestion process thereby correspondingly decreased. Because of the success of this plant, as shown by these experiments, other plants are being built of a similar nature, the results of which will be awaited with much interest.

It is believed that foaming is more or less a natural reaction accompanying sludge digestion, and that it is not good policy to spend so much time and money in combating this condition. The ideal situation would be to design a tank that would take care of this natural condition. There are indications that this type of tank meets the requirements.

Table No. 7—Cost of Operation of Plant.

Month	Power	Light	Labor	Mainten- ance	Repairs	Cost for Pumping Stations	Cost for Com- plete Plant
1926							
July	\$19.16	\$1.00	\$217.78	\$ 68.88	\$4.74	\$103.13	\$ 311.56
August	20.58	1.00	121.74	14.25	9.02	146.24	166.59
September	20.10	1.00	132.28	41.68		130.74	195.06
October	46.22	1.00	277.18	145.06		173.18	469.46
November	16.98	1.00	129.28	38.60		101.94	185.86
December	13.78	1.00	248.84	145.93		156.80	409.55
1927							
January	51.02	1.00	131.30	118.73	1.75	119.03	303.50
February	29.24	1.00	190.08	28.23		152.72	248.55
March		1.00	145.20	279.88	5.80	53.31	431.88
April	75.19	1.00	392.20	125.01		310.24	593.40
May	12.52	1.00	277.98	20.28		133.58	311.78
June		1.00	141.42	17.15		33.08	159.57
July	98.64	1.00	696.15	217.23		284.24	1,013.02
Annual Cost	\$403.43	\$13.00	\$3,101.13	\$1,260.91	\$21.31		\$4,799.78

Acknowledgment. Acknowledgment is given to the following for their assistance in helping to accumulate the above data: R. Case, plant operator; I. R. Riker and C. W. Sparmaker of the New Jersey State Board of Health, and Mr. Thorpe; and C. E. Albright, Philadelphia, Pa., for assistance in preparing the charts and arranging the data.

No Roadside Tree Planting in Missouri

Tree planting upon rights-of-way of state highways in Missouri has not thus far been permitted. While trees may add to the beauty of the roadway in some instances, they may also be a nuisance, an item of expense, and even a danger, since they frequently block drainage, and interfere with ditch cleaning, widening of shoulders or road, and erection of telephone or power lines. Fallen leaves interfere with the drainage structures, while the trees themselves are a danger, especially during sleet storms. It is considered more desirable to have the trees planted ten or fifteen feet off the right-of-way, in clusters separated by proper intervals.

Road Material Inspection Costs

The Missouri State Highway Department in 1925 changed its plans of financing the work of testing, this now being handled by means of a budget system. The unit cost of cement inspection for 16 months in 1925 and 1926 was 1.35 cents as compared to a commercial price of about 2.5 cents formerly bid. This represents a saving of approximately \$33,000 for the past two years. The unit cost of inspecting aggregate and surfacing gravel has been 4.68 cents per ton.

Studies of Efficiency of Water-Purification Processes

Undertaken as part of stream pollution investigations of Public Health Service. Relationships between bacterial quality of raw water and quality of effluents from purification plants.

Studies of the bacterial efficiency of municipal water purification plants have formed a logical part of the stream pollution investigations undertaken by the Public Health Service under authority of an act of Congress of 1912. These investigations, having dealt principally with the public health aspects of stream pollution, the safety of public water supplies, and, more especially, the relation between the sanitary quality of such supplies and the permissible degree of pollution of their sources, have been subjects of basic importance for inquiry. A report on these studies by sanitary engineer H. W. Streeter, has just been issued as Public Health Bulletin No. 172. (A description of an experimental plant at Cincinnati used by the P. H. S., and a preliminary report by Mr. Streeter on the conclusions from the studies, were published in the November, 1926 issue of PUBLIC WORKS.)

The main objectives of the studies dealt with in this report are the following:

(a) An appraisal of the bacterial efficiency of well-designed and well-operated municipal water purification plants treating sewage-polluted river waters; and

(b) A determination, if possible, of the maximum limit of bacterial pollution of river water supplies, as delivered for treatment, consistent with the production of effluents conforming to specified standards of bacterial quality.

In the latter connection, reference is made to a limiting standard, recommended in 1914 by the International Joint Commission, defining the maximum permissible density of *B. coli* in raw waters taken from the international boundary waters of Canada and the United States for purification.

During a period of thirteen months in 1915-16, the Public Health Service undertook a preliminary observational study of the Cincinnati and Louisville filtration plants, taking their raw water supplies from the Ohio river. From this study a well-defined relation was found to exist between variations in the bacterial quality of the raw water and concurrent variations in the quality of the effluents obtained at successive stages of treatment, including the final stage. From this relationship it was indicated that the maximum *B. coli* index of the raw water, consistent with the production of a final (chlorinated) effluent conforming to the original United States Treasury Department drinking water standard, was about 630 per 100 cubic centimeters. The corresponding limit fixed by the International Joint Commission raw water standard was 500 *B. coli* (index) per 100 cubic centimeters.

Further studies of the problem were delayed, owing to the war, and were not resumed until 1923, when a collective survey of seventeen municipal water-filtration plants was undertaken, ten of these plants being located along the Ohio river and the remainder on other rivers in the Eastern and Middle Western States. From this survey, the following tentative conclusions were drawn:

1. Under normal conditions of their operation, all of the plants studied have shown a fairly definite relationship as existing between variations in the bacterial quality of their raw-water supplies and concurrent variations in the quality of effluents produced by them at successive stages of treatment.

2. In general, the nature of this relationship has been found to be expressed by the equation $E=cR^n$, in which (R) represents the bacterial content of the raw, or influent, water, (E) that of the effluent water, and (c) and (n) empirical constants.

3. The over-all efficiency of bacterial purification, when expressed in terms of *B. coli* removal, appears to be influenced to a relatively slight, if any, extent by changes in temperature and other seasonal conditions, or by variations in raw-water turbidity, all other conditions being equal.

4. According to the best statistical evidence afforded by the surveys, as based on the mean performance of the ten Ohio river plants, the maximum *B. coli* index of raw river waters of the Ohio river type, consistent with producing a final chlorinated effluent conforming to the revised Treasury Department standard, approximates 5,000 per 100 cubic centimeters. The corresponding maximum raw-water *B. coli* index consistent with producing unchlorinated effluents meeting the same standard was found, however, to average as low as 60 per 100 cubic centimeters. Plants more highly elaborated than the average, such as those equipped with double-stage sedimentation and coagulation, appear to be able to produce satisfactory chlorinated effluents from river waters having a *B. coli* index somewhat in excess of 10,000 per 100 cubic centimeters.

5. Water purification plants operated along the Ohio river are unable, under existing conditions of pollution of this stream, to produce unchlorinated effluents conforming, as an average, to the revised Treasury Department *B. coli* standard, though they are able, by the continuous and effective use of chlorine, to produce, for a large part of the time, chlorinated effluents meeting this standard. On the basis of the average limit of tolerance above stated, two of the Ohio river plants surveyed, located, respectively, at Ironton, Ohio, and Ashland, Ky., were indicated as being overburdened by excessive bacterial pollution of the river in the zone from which their raw-water supplies are obtained.

6. With one exception, all of the seven plants surveyed, located elsewhere than on the Ohio river, were able to produce satisfactory final effluents from raw waters having a *B. coli* index not exceeding 5,000 per 100 cubic centimeters. Two plants of this group, located, respectively, at Albany, N. Y., and Chester, Pa., were shown to be overburdened by excessive raw water pollution, on the basis of the criterion above given.

Aside from those above stated, no final conclusions

can be drawn from the surveys described until their results have been checked against the results of experimental studies in progress at this time, and possibly also further surveys of full-scale plants located in other sections of the country. Systematic and well-correlated observations of full-scale plant performance thus far have included no examples of plants found west of the Mississippi river and but one example of plants treating water from the Great Lakes.

Friction Losses in Cement Lined and Tar Coated Pipe*

In order to determine the relative losses of head in cement lined and tar coated cast-iron pipe, respectively, tests were conducted at the hydraulic laboratory of the University of Illinois for the American Cast Iron Pipe Co., 4-inch, 6-inch and 8-inch pipe being used in the tests. The lengths of line between the piezometers which measured the pressure heads varied from 181 to 218½ feet for the different sizes.

After plotting the results of the tests, the following equations were determined as representing them quite closely:

$$\text{For cement lined pipe—} h = 1.10 \frac{Q^{1.83}}{d^{4.89}}$$

$$\text{For tar coated pipe—} h = 0.94 \frac{Q^{1.94}}{d^{5.00}}$$

In which h is the loss of head per thousand feet, Q is the rate of discharge in gallons per minute, and d is the actual mean diameter in inches.

Cement lined pipe has a much smoother interior surface than new tar coated cast iron pipe. An uncoated cast iron pipe has a relatively rough interior surface. The tar coating makes the surface smoother, but there are many pinnacles which project above the general surface and cause a decided disturbance in the flow of water. The cement lining is, or should be, thick enough to cover the pinnacles. The wetted surface can be made very smooth by means of the cement lining. The bond between the pinnacles and the cement no doubt explains the adhesion which permits cutting and caking without serious injury to the cement lining.

The effect of the increased smoothness of the cement lined pipe is to give it a greater carrying capacity for a given loss of head than new tar coated pipe of the same diameter, compensating for the reduction in internal diameter due to the cement lining. The tests indicate that, for velocities of flow between 1 and 2 feet per second, a cement lined pipe having an internal diameter 3 per cent less than new tar coated pipe has about the same carrying capacity. At velocities between 9 and 10 feet per second a cement lined pipe having an internal diameter 7 per cent less than new tar coated pipe has about the same carrying capacity.

The relative smoothness of the two linings is shown by the values of "C" in the Hazen and Wil-

*Abstract of a paper by Melvin L. Enger, Professor of Mechanics and Hydraulics, University of Illinois, before the American Water Works Association.

liams formula from the tests calculated for a velocity of about 3.14 feet per second. These values are shown below.

KIND OF LINING	INTERNAL DIAMETER inches	COEFFICIENT C IN HAZEN AND WILLIAMS FORMULA
Cement lined pipe.....	3.61	149
	5.84	151
	7.86	150
Tar coated pipe.....	3.96	134
	5.88	140
	7.97	132

Economic Side of Sewage Disposal

There should be an economic side to investments totaling more than one hundred million dollars. Relief of water purification plants. Elimination of damage suits. Sale of liquid and sludge, and use of gas.

The subject of the economic side of sewage disposal was discussed before the Missouri conference on Water Purification and also before the Iowa Conference on Sewage Disposal by N. T. Veatch, of Kansas City. Mr. Veatch opened his paper by stating that little if any thought has generally been given to the economic side of sewage disposal. In considering the economic side of the average utility, it is possible to make estimates, and later definite statements, showing the operating expenses, revenue obtained, etc., and the economic value in dollars and cents. In the case of sewage disposal, however, with few exceptions such as the sale of purified sewage for irrigation, sale of sludge for fertilizer, etc., there is no revenue with which to offset operating and fixed charges.

It is very difficult to even estimate the total investment in disposal works in the United States, since the type of plant differs in almost every city. An investigation of some 80 disposal plants for which accurate cost data were available, and correcting for difference between pre-war and present costs, which plants are serving cities ranging in size from 1,500 to 50,000 population, gave average per capita costs of \$4.37 for primary treatment and \$10.43 for complete treatment. The primary treatment plants, however, varied from \$1.46 to \$8.70 per capita, and complete treatment plants from \$4.44 to \$19.50 per capita. Too much reliance, therefore, should not be placed upon the averages. Metcalf & Eddy in 1915 estimated that 41,800,000 persons were served by sewerage systems and that the sewage of about 84 per cent of this population was disposed of by dilution. This would give a population of 6,700,000 whose sewage was being treated in disposal plants. Since then, hundreds of small cities and several large ones have installed disposal plants and it is probable that at least 65,000,000 people reside in cities served by sewerage systems at this time and that the sewage from at least 20 per cent of that number is treated at disposal works; which

assumption would give at least 12,000,000 receiving some sort of sewage treatment, which figure is probably too low.

"It seems entirely reasonable to assume that there is at this time a total investment in this country for sewage disposal works of at least \$100,000,000, and probably quite a little more. At any rate this vast sum of money already invested, and the large sums already contemplated for plants throughout the country, should, it seems, be ample proof that sewage disposal should at least have an economic side."

In the fall of 1917 the aggregate amount of water used by Kansas municipalities along the Verdigris river was approximately three times the flow of the river at the Oklahoma state line. Without the help from sewage disposal plants it would have been impracticable to purify the water of this river so as to furnish safe water supplies for those cities. The value of pure water has been expressed in dollars and cents as representing the value of lives saved, but should not sewage purification be allotted a share of this appraisalment?

Considering trade wastes as a part of sewage, the mingling of these with domestic sewage makes the purification of the combined sewage more difficult and expensive in many cases. Oil well wastes and the accompanying salt water have ruined many public water supplies when discharged into streams, and it becomes a question of economics whether it would be cheaper to purify these wastes before discharging them into a stream, or to allow them to discharge into the stream and secure a supply from another source at greater cost. Creamery wastes also present a similar problem the proper solution of which is surely an economic study.

Perhaps the most potent argument in favor of sewage and waste treatment is the actual experience or possibility of damage suits. "It is often easy to justify the cost of disposal plants on account of the probability of their total cost being less than would have to be paid out in damages."

In addition to the economic side of the decision between disposal and no disposal, there is also an economic side to the art itself. While there are no records indicating that any disposal plant is self-supporting as are some of our utilities, there are a number of examples where some revenue is obtained. A few cities have been able to obtain some income from the sale of sludge, but farmers are not often enthusiastic about it as a fertilizer, due undoubtedly to the fact that few plants have been able to prepare the sludge in such a condition that they cared to handle it, much less to pay for it. By far the largest majority of plants are glad to give the sludge away to any one who will haul it. The amount of sludge from the large number of smaller disposal plants would not justify the cost of preparing them as a fertilizer, and it usually can be handled by lagooning or drying on porous drying beds.

There are several plants where the effluent is used for irrigation with a resultant return from crops. At Pomona, California, there is a disposal plant serving three cities with a combined population of 20,000, the contract price received for the effluent from which pays the yearly operating cost.

The gas obtained from sludge digestion can be used for commercial purposes. The amount ob-

tained depends upon the method of handling, the quantities apparently range from 0.3 to 0.5 cubic foot per capita per day. At Decatur, Illinois, gas collected from Imhoff tanks is used for heating and laboratory work at the plant, the amount produced per day being said to average about 100,000 cubic feet. It appears probable that the collection and use of gas from sludge digestion will play an important part in the future design of sewage disposal plants. It is being used in several places as fuel in heating systems used to keep a high maintained temperature in the digestion tanks, with the possibility of reducing the space required for digestion.

There are a great many plants throughout the country which are receiving improper care, if any, the investment in which represents an enormous sum; and considered economically, this certainly represents wasted investments.

Research in Sewage Purification

Arthur J. Martin, in a paper read at the Royal Sanitary Institute Congress in England, a few weeks ago, urged strongly the need for research in connection with the purification of sewage. He stated that the Royal Commission on Sewage Disposal in report after report had emphasized the need for research and recommended the establishment of a central authority to carry on this work. Apparently the chief obstacle to the carrying out of this recommendation is the difficulty of getting a bill through Parliament; in addition to which there is the question of financing the work. Of late years, however, largely through pressure exerted by the fishery interests, the question of river pollution has been revised. In 1921 a standing committee on rivers pollution was appointed by the Minister of Agriculture and Fisheries, and in November, 1923, this committee issued an introductory report, and has now established an experimental station for the investigation of pollution as affecting fish.

On February 15, 1927, a large and influential deputation from the joint committee of the British Water Works Association and the Salmon and Trout Association on Rivers Pollution urged upon Lord Balfour, president of the council, the appointment of a permanent central committee to deal with the question of pollution of rivers and waterways. The president expressed sympathy with their aims, stated that the Government was "quite convinced that some time must be taken in these researches" and that it was "prepared to supply the necessary financial resources and see that those investigations are adequately carried out."

Discussing the carrying out of this plan, Mr. Martin said that the obvious plan was to establish a Government laboratory; but that too much should not be expected from such a laboratory, for "the purification of sewage involves a large number of factors, and it is hardly possible to provide in a single establishment all the conditions which are necessary for dealing with it. It would, moreover, be a grave mistake to ignore the various agencies which are already members in the field." Managers, river boards, and universities are all carrying on experiments, and he referred to those being carried on by the University of Illinois in this country. He believed that what was needed in England was not so

much new agencies for research as the co-ordination and adequate support of those already at work. "The financial assistance promised by Lord Balfour could not be better applied than by maintaining research scholars engaged in the investigation of selected problems at universities or at sewage works presenting special facilities for such work."

Much of what Mr. Martin says applies to this country also; and his suggestion that funds be provided for maintaining scholars at existing sewage plants is one well worth considering. As he says, no one laboratory or operating plant can provide all of the various conditions which should be investigated and considered in making a comprehensive study of this subject.

Measuring Municipal Government

Suggestions for developing standards of measurement of administrative departments of municipal government.

"Municipal Government is constantly being measured or judged. Someone calls up the city hall and enters a complaint because a catch-basin on a certain street corner is flooded. A few days later the same person calls to report that nothing has been done about the complaint. 'This administration is terrible,' are likely to be his first words over the telephone. . . . Although the city deserves to be censured for laxity, the unfairness of such a basis for comparison is evident. . . . On the other hand, someone else may have received prompt attention to an equally trivial complaint; he is loud in his praise of the entire government. Certainly no administration should be appraised in its entirety on such insufficient grounds. . . . To draw conclusions from too few data is as likely to turn good men out of office and let rascals in as it is to turn the rascals out and put good men in."

The above is quoted from the introduction to an 88-page pamphlet entitled "Measuring Municipal Government" written by Clarence E. Ridley, former city engineer of Port Arthur, Texas, and later city manager of Bluefield, W. Va.

He gives his aim in this report as being to aid in developing standards of measurement of the results of various municipal departments. Such standards are unquestionably difficult to evolve. "Character of population, climate, physical conditions, etc., are never quite the same in any two cities. Economic pressure is causing within cities changes which are almost unbelievable. All of these factors complicate the problem."

Mr. Ridley considers general community activities under the several heads of Fire Protection, Public Health, Police Protection and Public Works, as being the four chief administrative departments of a municipal government.

Under the head of Fire protection he considers the National Board of Fire Underwriters' rating

schedule and various collections of fire statistics. Under Public Health he considers the American Public Health Association appraisal form. Naturally we are most interested by his chapter on Public Works.

In estimating the success of a city government by consideration of its public works, he states that "the amount of effort the city should put into public works activities is largely determined by the standard of living of the city. . . . The people of some cities are content with unpaved and poorly lighted streets, while the people of other cities not only desire well paved streets but want them brilliantly illuminated and immaculately cleaned as well. Such services are therefore more dependent upon the wealth, pride and habits of the people than are the services rendered by the fire, police or health departments." While these departments "may be appraised by the effectiveness of the protection afforded the citizens, the activities of the public works department can best be appraised by the economy of administering those functions which the standard of living of the particular city demands."

"A public works activity must be separated into functions before an intelligent appraisal can be made. In general, statistics on public works activities have been of little value for purposes of comparison between cities. This has been due largely to existing lack of uniformity in the standards of measurement and the confusion in interpreting those standards which appear uniform."

Mr. Ridley then proceeds to propose general standards of measurements under the various heads of streets, street cleaning, snow removal, street lighting, sewers, refuse collection and disposal, and water supply. He discusses each of these at some length, calling attention to complicating features which are well known to municipal engineers, such as the several elements of excavation, foundation, pavement surface, curbs and headers in pavement construction; the several kinds of equipment used for cleaning the streets and the occasional overlapping of work done by different methods, such as gutter sweepers accompanying sprinklers, etc.

His summary of standards of measurement for the activities of a public works department are as follows: "1—Streets. Standards of measurement for pavement construction may be expressed in excavation per cubic yard for each class of material, the curbing per lineal foot and the pavement proper per square yard; for pavement maintenance, per mile for the 'modalage' of the total pavement mileage; for maintenance of unpaved streets, in lineal distance; and for construction of crosswalks and sidewalks, per square foot. It is distinctly understood, however, that any standards are useless unless such factors as specifications, labor, cost of materials, etc., are given to consideration.

"2—Street Cleaning. Standards of measurement for street cleaning may be expressed in 'great squares' classified according to the different methods of cleaning, but many compli-

cated factors must be considered. Snow removal measurement standards vary according to the nature of the particular work, but snow falls differ so widely in quality as well as quantity that it is doubtful if any existing measurement is very accurate and reliable.

"3—Street Lighting. The measurement of this activity on a comparable basis is contingent upon further standardization of methods.

"4—Sewers. Standards of measurement for sewer construction may be expressed in cubic yards of different classes of excavated material, the lineal feet and size of pipe laid, the manholes per foot of depth and the catch basins per unit. Sewer maintenance may be measured by the total length of the average pipe. (The diameter of the size which, having the same length as the combined length of all the sizes in use, would have also the same cubic contents.)

"5—Refuse. Standards of measurement for municipal refuse may be expressed either in tons or in cubic yards for collection and ton-miles or cubic yard-miles for hauling.

"6—Water Supply. Measurement standards for extensions to the distribution system may be based on the cost per mile for certain size pipe if class of pipe, depth laid, and character of earth formation are given. In the supplying of water to consumers, comparisons are made on the basis of gallons or cubic feet. Such standards of measurement, however, are worthless unless the different operations between the source and consumer are separated into a functional classification such as source of supply, delivery to purification plant, cost of purification and cost of distribution.

"7—Finally, the development of useful and practical measurement standards for the activities of a public works department presents difficulties at variance with those met with in the other departments, in that public works has a less definite objective. It should also be noted that public works activities involve material and equipment to a much greater extent, thus necessitating the consideration of more varied factors."

In concluding his thesis Mr. Ridley says: "The results of government are measurable. . . . The administration of government will become a science only to the degree that the results of government activities are subjected to measurement."

Salaries on Road Work

The average salaries of employees of the Missouri State Highway Department, according to the 1926 annual report, are as follows:

	Number of employees	Average salary
Administration (only those directly in responsible charge)	102	\$250.49
Engineers on special assignment	9	233.88
Project and field engineers (now in charge of projects and having limited administrative authority)	107	207.24
Designers and computers	33	184.39
Office engineers (employed on detail or having limited administrative authority)	30	176.16
Right-of-way men in division offices....	26	164.80

Assistant project engineers and inspectors (men under project engineers)	385	158.61
Chemists	12	154.16
Clerical (auditors, bookkeepers and clerks)	98	135.10
Mechanics and helpers	20	129.50
Maintenance (patrolmen, gradermen and helpers)	738	105.00
Stenographers and typists	61	104.01
Miscellaneous field men (rodmen, chainmen, etc.)	112	90.98
Miscellaneous office help	9	56.11
	1,742	\$123.45

The salary rates for 1926 were somewhat increased with the result that the turnover was reduced from 68 per cent in 1925 to 45 per cent in 1926. There were 443 resignations and 725 employments in 1925, and 337 resignations and 490 employments in 1926. The employment schedule and classification are as follows:

Grade 1.—Assistant bureau chiefs; sub-bureau assistants; engineers on special assignments; special project engineers; assistant division engineers. Salary, \$230 to \$275 per month.

Grade 2.—Assistant division engineers; sub-bureau assistants; division, construction, plan and survey and materials engineers; including laboratory engineers, chief materials inspectors and geologists; project engineers, concrete paving and large bridges; special bridge and plan and survey designers. Salary, \$215 to \$225.

Grade 3.—Project engineers, heavy grading, gravel paving, and small bridges; sub-bureau assistants; chief of parties, construction or plan and survey; designers, bridge and plan and survey. Salary, \$200 to \$210.

Grade 4.—Project engineers, light grading, small bridges and culverts; assistant project engineers, heavy work or not directly with or under a project engineer; office engineers, bookkeepers and clerks. Salary, \$175 to \$195.

Grade 5.—Instrumentmen, construction and plan and survey; inspectors, concrete paving or large bridges; assistant project engineers, working with or directly under a project engineer; right-of-way engineers; draftsmen, tracers and computers; head estimate checkers; bookkeepers and clerks; laboratory assistants and field inspectors. Salary, \$140 to \$170.

Grade 6.—Construction inspectors, gravel, small structures, mixing or producing plants; laboratory assistants and field engineers; draftsmen, tracers and computers; stenographers and clerks. Salary \$100 to \$135.

Grade 7.—Rodmen, chainmen, axmen, stakemen and helpers; file clerks; stenographers and typists. Salary \$65 to \$95.

Municipal Engineering Positions and Salaries

The subject of increased salaries for those employed in city engineering departments, and of classification of positions as a preliminary to such increase, was presented before the annual meeting of the City Engineers of New York State (a section of the State Conference of Mayors and Other City Officials) by Nelson F. Pitts, Jr., city engineer of Syracuse, N. Y.

Said Mr. Pitts: "Salaries are not commensurate

with the service demanded. The average remuneration of those engaged in the various duties of municipal bureaus of engineering is inconsistently low for the executive and technical ability, the intelligence, training and natural skill required." He considered it the duty of the association to co-operate in the nation-wide campaign now under way for increased salaries to engineers.

As a preliminary to this, he considered that "Classification is the first essential. It is the foundation on which the adequate salary scale must be built. . . . Reduction in the number of titles for engineering positions is one essential for reorganization. Many of these titles and positions are obsolete. Many do not accurately describe the nature of the work being performed. Use of fewer and standardized titles would be a great stride forward in the project for better organization. In the cities of the state, outside of Greater New York, there are about fifty different designations for positions in municipal engineering offices. In some cities these mean one thing; in others, another. It is perfectly feasible and practical to reduce this large number to a classification of not more than eleven titles, as follows:

City Engineer.

Deputy Engineer.

Senior Assistant Engineer, Grade A.

Senior Assistant Engineer, Grade B.

Senior Assistant Engineer, Grade C.

Junior Assistant Engineer, Grade A.

Junior Assistant Engineer, Grade B.

Junior Assistant Engineer, Grade C.

Surveyors.

Senior Aids.

Junior Aids.

"Under such classification, any number of senior assistants could be employed in all or in some of the grades. Their work could be so assigned as to limit the necessity of so many engineering titles for performing the various classes of work.

"Standardization of salaries naturally follows classification of positions. It must be admitted that the present rate of remuneration is far below a just standard. It calls for correction and that is what we are endeavoring to obtain.

"I am presenting a table of possible salaries, increased above the present scale and applicable to cities whose municipal work and problems are similar to those in Syracuse, cities about 200,000 in population. From this table I have purposely omitted the salary of the city engineer, for reasons which I stated at the outset.*

"The table follows:

Deputy city engineer	\$5,000
Division engineer	4,400
Office engineer	3,800
Assistant engineer, first grade	3,500
Assistant engineer, second grade...	2,700
Testing engineer, chemist or bacteriologist	3,500
Instrumentmen	2,800
Draftsmen, first grade	2,800
Draftsmen, second grade	2,000
Rodmen, chainmen, or tracers	1,800"

*"In making this appeal for more commensurate salaries, I have no personal nor ulterior motives. Personally I ask no greater recompense."

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CONTENTS

STREET CLEANING, REFUSE COLLECTION AND SNOW REMOVAL IN NEWARK. Illustrated.....	447
Dust Prevention in Missouri	450
Holding a Sliding Hill. Illustrated	451
THE SAO PAULO AQUEDUCT. Illustrated	451
REFUSE DISPOSAL IN ENGLAND	453
SNOW HANDLING IN NORTH DAKOTA	454
Sewer Connections in San Francisco	454
DIGESTION OF SEWAGE SCREENINGS. Illustrated. By H. Heukelekian	455
DETERMINATION OF MOISTURE IN AGGREGATE. Illustrated	457
Pointing Masonry with Cement. Illustrated	458
Construction Work on Atlanta-Macon Road	458
LIGHT ASPHALTIC OIL ROAD SURFACES. Illustrated	459
KEEPING RHODE ISLAND ROADS OPEN IN WINTER. Illustrated. By D. D. Bouchard....	464
RECENT DEVELOPMENTS IN SEWAGE CHLORINATION	465
Ancient Tunnel Surveying	468
THE MERCHANTVILLE-PENSAUKEN SEWAGE TREATMENT PLANT. Illustrated. By Major Michael J. Blew	468
No Roadside Tree Planting in Missouri	473
STUDIES OF EFFICIENCY OF WATER PURIFICATION PROCESSES	473
Friction Losses in Cement Lined and Tar Coated Pipe	474
ECONOMIC SIDE OF SEWAGE DISPOSAL ..	475
Research in Sewage Purification	476
MEASURING MUNICIPAL GOVERNMENT	476
Salaries on Road Work	477
Municipal Engineering Positions and Salaries	478
EDITORIAL NOTES	479
Machines or Man-Power-The Convention and Road Show-Practice in Refuse Disposal.	
Machinery in Refuse Collection, Street Cleaning and Snow Removal	480
Street Cleaning Costs	480
REFUSE COLLECTION AND DISPOSAL, STREET CLEANING AND SNOW REMOVAL	481
Wages Paid Common Labor	481
Statistics of Refuse Collection	482
Oakland-Alameda Estuary Subway	484
THE A. S. M. I. CONVENTION	484
Report of Committee of A. S. M. I. on Street Maintenance Street Cleaning and Snow Removal.....	485
Refuse Collection and Disposal in Chicago	486

Machines or Man-Power

On another page of this issue are given the results of a survey showing the use of machinery and cost-saving devices in refuse collection and disposal, street cleaning, and snow removal in a number of cities.

The fact that 27 per cent of the cities reporting purchased motor driven street sweepers during the past year is an indication that in this line of work the engineers in charge are alive to the value of modern labor-saving machinery. Snow loaders were purchased during the past year by 12 per cent of the cities reporting, which is a satisfactory figure, considering that only about half of the cities reporting were in the snow belt, and others were not of a size to justify snow removal. Tractors, trucks, snow plows, and street flushers were bought quite freely. The amount of this equipment owned by these cities totals up to an astonishing figure.

Refuse collection and street cleaning yield no income, but are sources of considerable expense, and often of complaint on the part of the public. Replacement of men by machinery in refuse collection has not yet been possible to any considerable extent, but recently there has been much progress in the use of more economical means of transportation, such as motor trucks of greater capacity. Some interesting developments in this line are described in the leading article in this issue.

In street cleaning, there is greater opportunity for the use of labor saving devices. While in the past, cities appear to have been slow to realize the advantages of modern cost-saving equipment, motor sweepers and flushers are now coming more into use. Their economy—under ordinary conditions machine sweeping costs about one-half as much as hand sweeping—reliability and serviceability are now quite generally recognized.

Snow removal is costly, and requires a high degree of managerial ability. The problems involved in the mobilization of an army of men, and their economical employment under the adverse conditions encountered in snow fighting, are very great. The substitution of plows, trucks, scrapers, and snow loaders has, to some extent, simplified the problem, and has resulted in a considerable financial saving.

Perhaps because these activities produce no apparent income, but are a drain upon the resources of a city, expenditures are watched more closely, and those in charge are more alert for opportunities to cut down costs and reduce the element of unreliability by substituting mechanical appliances for man power.

The Convention and Road Show

Twenty-five years ago a group of engineers inaugurated the American Road Builders' Association. The convention and road show that will be opened in Cleveland next month will testify to the great developments in the industry that have taken place since that time. Years ago, the convention, made up almost entirely of engineers, discussed the best methods of construction, and the economy and value of the various types of roads then in use. Later, the question of maintenance arose, and became as it is today, one of the most important problems the road

builder has to face. Now, in addition to construction and maintenance, there is the problem of building to handle safely and swiftly the tremendous tide of present-day traffic.

During the past few years, the American Road Builders' Association has come quite properly to represent the highway industry, an industry through which the country will this year invest a billion dollars in road work. That properly conceived, designed, constructed and maintained highways are an investment has been proven pretty well beyond dispute; and for the knowledge and skill responsible for proper planning and construction, the American Road Builders' Association and similar bodies which offer opportunity for instruction and interchange of knowledge among engineers, contractors, and officials, are at least in part responsible.

The Association is to be congratulated on its quarter century of useful life. Undoubtedly it will continue for many years an institution of great value to the road-building industry.

Practices in Refuse Disposal

The present trend in refuse disposal appears to be quite definitely toward incineration. Of 162 cities reporting special information for this issue, 11 reported changing the method of disposal during the past two years; 144 reported no change, and 10 did not report. Incineration was adopted by 8 of the 11 cities reporting changes. These were: Gary, Indiana; Freeport, Niagara Falls, and Utica, New York; Raleigh, North Carolina; Hamilton, Ohio; Danville, Virginia; and Fairmont, West Virginia. Lansing, Michigan, which formerly used its garbage for feeding pigs at the city farm, now sells it to a contractor. The method of ultimate disposal is not stated. Lakewood, Ohio, sells its garbage to a reduction plant, and Amarillo, Texas, has adopted feeding to pigs.

A total of 31 cities report that they are now in the market for, or are considering the use of, incinerators. Some of these projects are quite far in the future, but the indications are that incineration as a method of refuse disposal is steadily gaining in favor because of its advantages under most conditions of use.

Machinery in Refuse Collection, Street Cleaning and Snow Removal

Replies have been received from 140 cities to the question "What mechanical appliances, if any, have you substituted for hand labor in street cleaning and snow removal during the past year?" In collecting this information, no attempt was made to secure complete coverage, but information was obtained only with the intention of getting reliable data regarding the present trend of practice in a representative list of cities, large and small.

Of the 140 cities, 69, or practically 50 per cent, reported the substitution of mechanical appliances for hand labor. Street sweepers appeared to be the most favored type of equipment, and 38 cities reported the adoption of this type of equipment; several of them reported purchasing two or more sweepers; and all but two or three of these were of the motor pick-up type. Snow plows were

by 35 cities, or 25 per cent of those reporting. Tractors were purchased by 18, and snow loaders by 16. In some cases four or five or more loaders were purchased. Nine motor trucks were purchased for similar use, and 4 motor street flushers.

The equipment employed by the cities reporting represents an impressive total. There were reported as in use 195 horse drawn flushers; 261 motor flushers; 288 horse drawn sprinklers; 79 motor sprinklers; 518 street dirt carts and wagons; 1,248 garbage carts and wagons; 1,866 motor trucks employed on garbage, ash and refuse collection; 441 tractors; 537 garbage trailers; 679 ash and rubbish trailers; 807 ash and rubbish carts and wagons; 1,234 snow plows; 50 snow loaders; 52 horse drawn machine brooms; 45 motor driven machine brooms; 85 pick-up sweepers; and 15 vacuum cleaners.

This equipment represents that used by somewhat over 10 per cent of the 1,467 cities having a population of over 5,000, but in the list are included a number of the larger cities.

Street Cleaning Costs

The following information regarding costs on street cleaning work has been furnished by the various cities:

Fort Smith, Arkansas. The city has an Austin sweeper which has been in operation 3 years. The cost of cleaning with this machine is 22 cents a thousand square yards which is approximately one-fifth the cost of hand cleaning.

Miami, Florida. The cost of hand labor sweeping, which is used only on gutters, is 40 cents per thousand square yards; motor sweeping machines operate at a cost of 21.7 cents, and flushers at 10.1 cents per thousand square yards, which figures include labor, maintenance, supervision, overhead, interest, and depreciation. The above figures are for October, 1927.

St. Augustine, Florida. The city has added a pick-up sweeper recently and reports a saving of 20 per cent in cost, and no noise or dust.

Chicago, Ill. More than two million square yards of streets were cleaned by the block and gang system during 1926, the cost being 86 cents per thousand square yards. During the same period, auto flushers were used on 813,971,520 square yards at a cost of 8.7 cents per thousand square yards; and 6,986,320 square yards were cleaned by motor pick-up sweepers at 23.7 cents per thousand square yards.

Little Falls, New York. A motor pick-up sweeper saves about 25 per cent as compared to hand sweeping.

Utica, New York. Exact figures are not available, but there is no question as to cheapness of mechanical methods as compared to hand cleaning.

Raleigh, North Carolina. Mechanical sweepers cost less than half as much as hand work, which is now used only on gutter cleaning.

Norfolk, Virginia. Hand sweeping costs 20 cents per thousand square yards, as against 8 cents for machine work. By reducing the force necessary to accomplish the work, a \$6,000 sweeper has paid for itself in two years.

Kenosha, Wisconsin. Street cleaning costs have been cut over one-half since a motor pick-up sweeper has been in operation.

Refuse Collection and Disposal, Street Cleaning, and Snow Removal

Data from about two hundred cities regarding wages paid common labor, practice in collecting refuse, amount of garbage per capita, and costs of street cleaning. Machinery used in street cleaning and snow removal.

In this issue, PUBLIC WORKS presents, as has been its custom for many years, data on practices and costs in refuse collection and disposal, street cleaning, and snow removal. This information has been made available through the assistance and cooperation of officials in charge of this work in about 200 cities.

No particular effort has been made to secure re-

turns from a large number of cities, but the intention has been rather to obtain data from a number of representative cities of all sizes and from all parts of the country. Nor has it been considered desirable to present a mass of statistics. Instead, a summary of the information showing trends and practices is given under the various heads, along with some statistical data regarding costs and methods.

Wages Paid Common Labor

Information furnished by nearly 200 cities regarding the wages paid laborers engaged in street cleaning and snow removal work is presented in the accompanying table. Prices paid for labor appear to be higher in the western states, where the average price is about 62½ cents per hour; but wages in the east are almost as high. In the south, as might be expected, labor is paid much less—generally around 25 to 30 cents an hour, and for the most part the men work 9 hours.

Wherever possible, the data have been given on the basis of the hourly rate, but in some cases the daily rate is shown.

State and City	Amount Paid Per Hour	Common Labor Per Day
Arizona:		
Nogales	304	....
Arkansas:		
Fort Smith .....	....	\$3.00
California:		
Alameda	62½	....
Anaheim .....	....	\$110.00 m
Marysville	50	....
Napa	50	....
Sacramento	62½	....
San Rafael .....	....	4.50-5.00
Santa Clara	40	....
Vallejo	62½	....
Colorado:		
Denver	62½	....
Pueblo .....	....	4.20
Trinidad	45	....
Connecticut:		
East Hartford	50	....
Manchester	50	....
New Britain	50	....
New London	50	....
Stratford	50	....
Willimantic	45	....
District of Columbia:		
Washington	45	....
Florida:		
Miami	30	....
St. Augustine	35½	....
St. Petersburg .....	....	2.50
Georgia:		
Decatur	25	....
Idaho:		
Pocatello	62½	....
Illinois:		
Belvidere	40-50	....
Centralia	50-60	....

State and City	Amount Paid Per Hour	Common Labor Per Day
Cicero	60	....
La Grange	60	....
Oak Park	40-50	....
Ottawa	80	....
Urbana	60	....
Indiana:		
Gary	50	....
Madison	35a	....
New Albany	30	....
Rushville	45	....
South Bend	60	....
Kansas:		
Atchison	40	....
Louisiana:		
Lake Charles	25	....
New Orleans	40-50	....
Maine:		
Bangor .....	....	3.50
Rumford	50	....
Waterville	40	....
Massachusetts:		
Andover	56	....
Beverly	56½	....
Brookline	40	....
Framingham	56	....
Malden	62½	....
Newton	63	....
Palmer	50	....
Saugus	55	....
Southbridge	50	....
Michigan:		
Escanaba	40	....
Flint	50	....
Hastings	40	....
Ionia	45	....
Iron Mountain	44	....
Lansing	50	....
Niles	45-50	....
Pontiac	50	....
Sault Ste Marie	44	....
Wyandotte	45-65	....
Minnesota:		
Fergus Falls	37½	....
Little Falls	32½	....
Minneapolis	56-62½	....
St. Paul	45	....
Virginia	56	....
Missouri:		
Fulton	40	....
Joplin	44	....
Kirksville	50	....
St. Joseph	40	....
Trenton	33	....
University City	40-50	....
Montana:		
Great Falls	63	....
Lewistown	56½	....
Missoula	62½	....
Nebraska:		
Fairbury	35	....
Omaha	40	....
York	40	....

State and City	Amount Paid Common Labor Per Hour	Per Day	State and City	Amount Paid Common Labor Per Hour	Per Day
Nevada:			Wisconsin:		
Reno	56	....	Antigo .....	....	3.00-5.00
New Hampshire:			Appleton	50	....
Lebanon	40	....	Beloit	40-50	....
New Jersey:			Kenosha	50	....
Bellefonte	65	....	Rhineland	50	....
Bridgeton .....	....	20.00 w	Stevens Point	35-45	....
Perth Amboy	50	....	Wyoming:		
Ridgewood	75	....	Cheyenne	50	....
Salem	37 1/2	....		
New York:					
Binghamton	50	....		
Endicott	50	....		
Freeport	50	....		
Geneva	50	....		
Lackawanna .....	....	3.50			
Little Falls	45	....		
New York	50	....		
Niagara Falls	40	....		
Rockville Center .....	....	5.50			
Schenectady .....	....	4.50			
Seneca Falls	40	....		
Tarrytown	75	....		
Utica .....	....	3.75			
North Carolina:					
Gastonia	25	....		
Greensboro	27 1/2	....		
Raleigh	25	....		
Statesville	25	....		
Thomasville	25-27 1/2	....		
Ohio:					
Bellefontaine	40	....		
Cincinnati	47	....		
Defiance	35	....		
Delaware	40	....		
Hamilton	55	....		
Lakewood	57	....		
Xenia	40	....		
Oklahoma:					
Ardmore .....	....	90.00 m			
Henryetta	50	....		
Oregon:					
Astoria .....	....	4.80			
Oregon City	50	....		
Pennsylvania:					
Butler	40	....		
Clearfield	40	....		
Erle	45	....		
Freeland	56	....		
Hazleton	55	....		
Munhall	50	....		
New Brighton	45	....		
Norristown	50	....		
Oakmont	60	....		
Pottsville	45-55	....		
Scottsdale	40	....		
Scranton	58	....		
Rhode Island:					
Cranston	65	....		
Pawtucket	40	....		
South Carolina:					
Charleston	37 1/2	....		
Sumter	17 1/2	....		
South Dakota:					
Huron	40	....		
Lead	42 1/2	....		
Mitchell	40	....		
Tennessee:					
Jackson	30	....		
Knoxville	30	....		
Texas:					
Amarillo	50	....		
Austin .....	....	3.00			
Childress	37 1/2	....		
Greenville	37 1/2	....		
Marshall	25	....		
Tyler	25-28	....		
Utah:					
Provo	43 3/4	....		
Vermont:					
Bennington	50	....		
Virginia:					
Danville	25	....		
Lynchburg	25-27 1/2	....		
Newport News	35	....		
Norfolk	35-45	....		
Suffolk	25-30	....		
West Virginia:					
Clarksburg	50	....		
Fairmont	40	....		
Keyser	20	....		
Morgantown	50	....		

a—and upward; m—monthly; w—weekly.

Statistics of Refuse Collection

During the past month nearly two hundred cities have supplied us with data regarding refuse collection practice. Of the cities listed in the accompanying table, 63 or 39.9 per cent collect garbage with city forces; in 55 or 34.8 per cent it is collected by contract; and in 40, or 25.3 per cent it is collected by scavengers, either licensed or unlicensed. In general, collection by city forces is more common in larger cities, and collection by scavengers more general in small cities.

In response to questions regarding the amount of garbage, which was defined as "kitchen and table waste," most of the cities replied frankly that they had no records; a large number of the others gave indefinite figures. In an effort to make the information of the most practicable value, such statements were eliminated, and the data given in the table are believed to be reliable.

Unless otherwise stated, the figures in the table are pounds of kitchen and table waste per person per day or per year. Figures for garbage production are shown for 20 cities. These vary from one-third of a pound per day up to 570 pounds per year. Assuming 300 collection days, the minimum figure is 100 pounds. The average for the 20 cities is 314.2 pounds per person per year. This is nearly twice as great as the text-book figures commonly used and quoted, and it will be noted that, of the 20 cities, only 5 of them report a production under 200 pounds.

Undoubtedly the production of garbage is increasing with better living conditions, and with the greater year-round consumption of fruits and vegetables made possible by higher wages and better marketing.

Inclusion as garbage of other wastes may be a factor, but figures from such reliable sources as Norfolk, Va., Pawtucket, R. I., Raleigh, N. C., Flint, Mich., and Washington, D. C., point quite clearly to the upward trend.

City and State	Collection By	Amount of Garbage Per Capita Per Day or Year—Pounds
Arizona:		
Nogales	Contract	....
Arkansas:		
Fort Smith	City	....
California:		
Alameda	Scavenger	....
Anaheim	City	....
Marysville	Contract	....
Napa	Scavenger	1
Sacramento	City	400
San Rafael	Scavenger	2a
Santa Clara	Scavenger	....
Vallejo	Contract	....
Colorado:		
Denver	Contract	....
Pueblo	Contract	....
Trinidad	Contract	....

City and State	Collection By	Amount of Garbage Per Capita Per Day or Year—Pounds	City and State	Collection By	Amount of Garbage Per Capita Per Day or Year—Pounds
Connecticut:			Freeport Contract b		
East Hartford	Contract	....	Geneva	Contract	....
Manchester	City	....	Lackawanna	City	....
New Britain	Contract	....	Little Falls	Contract	....
New London	City	143	New York	City	....
Stratford	Scavenger	....	Niagara Falls	City	....
Torrington	Contract	....	Rockville Center	City	....
Willimantic	Contract	....	Schenectady	City	....
District of Columbia:			Seneca Falls	Contract b	....
Washington	City	275	Tarrytown	Contract	....
Florida:			Utica	City	....
Miami	City	800a	North Carolina:		
St. Augustine	City b	....	Gastonia	City	....
St. Petersburg	City	....	Greensboro	City	....
Georgia:			Raleigh	City	190
Decatur	City	....	Statesville	City	....
Gainesville	City	....	Thomasville	Scavengers	....
Idaho:			North Dakota:		
Pocatello	Contract	....	Fargo	Contract	....
Illinois:			Ohio:		
Centralla	Contract	....	Bellefontaine	Scavengers	....
Cicero	City	$\frac{3}{4}$ c. yd. c	Cincinnati	Contract	....
La Grange	City	525	Defiance	Scavenger	....
Oak Park	City d	500	Hamilton	Contract	185
Ottawa	Scavengers	....	Lakewood	City	1.08
Urbana	Scavengers	....	Xenia	Scavengers	....
Indiana:			Oklahoma:		
Gary	City	....	Ardmore	Contract	....
Madison	Contract	....	El Reno	Scavengers	....
New Albany	City	....	Henryetta	Scavengers	....
Rushville	Contract	....	Shawnee	Contract	....
South Bend	City	0.5	Oregon:		
Kansas:			Astoria	Scavengers	....
Atchison	Scavengers	....	Oregon City	Scavenger	....
Louisiana:			Pennsylvania:		
New Orleans	City	2a	Butler	Contract	....
Maine:			Clearfield	Scavengers	....
Bangor	Contract	....	Erie	City	....
Rumford	Contract	....	Freeland	Scavengers	....
Waterville	City	....	Hazleton	Contract	....
Massachusetts:			Munhall	City	250
Andover	Scavengers	....	New Brighton	Scavengers	....
Beverly	Contract	....	Norristown	Contract	....
Brookline	City	351	Oakmont	Contract	....
Frammingham	Contract	....	Pottsville	Contract	....
Malden	City	0.213 cu. yds. f.	Scottsdale	City	....
Newton	Contract	300	Scranton	City	....
Palmer	Scavengers	....	Rhode Island:		
Saugus	Contract	....	Cranston	Contract	....
Southbridge	Town	....	Pawtucket	Contract	264
Michigan:			South Carolina:		
Escanaba	City	....	Charleston	City	....
Flint	City	0.91	Sumter	City	....
Hastings	Contract	0.33g	South Dakota:		
Ironia	Contract	....	Huron	City	....
Iron Mountain	City	....	Lead	Contract	....
Lansing	City	....	Mitchell	Contract	....
Niles	Contract	....	Tennessee:		
Pontiac	Contract	....	Jackson	City	....
Sault Ste. Marie	Scavengers	....	Knoxville	City b	....
Wyandotte	Contract	....	Texas:		
Minnesota:			Amarillo	Contract	3.6 cu. yds. e f
Fergus Falls	Scavengers h	....	Austin	City b	....
Little Falls	Scavengers	....	Childress	Contract	....
Minneapolis	City	....	Greenville	Scavenger	....
St. Paul	City b	....	Marshall	Scavenger	....
Virginia	Contract	....	Tyler	Scavenger	....
Missouri:			Utah:		
Fulton	Scavengers	....	Provo	Scavengers b	....
Joplin	Scavengers	....	Vermont:		
Kirksville	Scavengers h	....	Bennington	Scavengers	....
St. Joseph	Contract	....	Virginia:		
Trenton	Scavenger	....	Danville	City	....
University City	City	1.9g	Lynchburg	City	500g
Montana:			Newport News	City	....
Great Falls	City	.0008 cu. yds. f	Norfolk	City	255.2k
Lewistown	Scavengers	....	Suffolk	City	....
Livingston	Contract	....	West Virginia:		
Nebraska:			Clarksburg	City	....
Fairbury	City	1.5	Fairmont	Contract	....
Omaha	Contract	....	Morgantown	City	....
York	Scavengers	....	Wisconsin:		
Nevada:			Appleton	Scavengers	....
Reno	Scavenger	....	Beloit	Contract	....
New Jersey:			Kenosha	City	4.75 e f
Belleville	Contract	....	Rhineland	Individual	....
Bridgeton	Contract	....	Stevens Point	Scavenger	....
Perth Amboy	City	....	Wyoming:		
Ridgewood	Scavengers	....	Cheyenne	Contract	101
Salem	Scavengers h	....		
New York:					
Binghamton	City	2.000e			
Endicott	City	....		

a—Garbage and rubbish; b—there are also some licensed scavengers; c—garbage and ashes per year; d—scavengers collect from business places; e—mixed refuse; f—per year; g—estimated; h—no license required; i—mixed refuse per day; k—these figures are for 1926; for first 9 months of 1927, total was 229.6 pounds.

Oakland-Alameda Estuary Subway

The method of constructing a vehicular subway under the estuary between Oakland and Alameda, California, by sinking and connecting together a series of pre-cast sections each more than 200 feet long, was described in the October 1926 issue of *PUBLIC WORKS*. The first section was sunk about October first of that year. The last section was sunk October 29th, 1927. There remains the work of completing the joints between segments and the interior construction, and back-filling the trench in which the tubes were laid. It is expected that the tunnel will be ready for service by next spring.

Papers and Discussions at the A.S.M.I. Con- vention

The first session on Tuesday was devoted to city planning and financing; Tuesday afternoon to reports of specification committees and representatives in the organizations; Wednesday morning to paving; Thursday morning to water supply, and Thursday afternoon to street lighting and sewage treatment. Preceding the convention proper, on Monday afternoon the nine specification committees held meetings.

On Tuesday morning, Major E. A. Wood, city engineer of Dallas, described the city plan soon to be submitted to the citizens, which embraces not only street plans, but schools and other public buildings, parks, sewers, incinerators, fire department, libraries, institute of fine arts, municipal auditorium, air port, hospitals, and water works extensions. The estimated cost, including engineering, is \$23,900,000. Jacob L. Crane, Jr., city planning engineer, of Chicago, in a paper entitled "Errors to Avoid in City Planning" gave a number of suggestions derived for past experience. Zoning laws must be reasonable and must be kept up to date. Some additional points were brought out in discussions by Morris Knowles, Geo. H. Herrold, Guy W. Haylis, A. J. Hawkins and P. L. Brockway. Mr. Herrold believed that there should be a special department of city planning, and existing officials should not be asked to take this on. Two of the above members considered it desirable to over-zone, especially the business areas. Richard Biehl, city manager of Two Rivers, Wisconsin, told how that city built practically all of its public improvements without issuing bonds. John B. Blandford, Jr., described Cincinnati's plan for programming public improvements.

Specifications.—There were few matters of importance, reported by the specifications committees. Geo. F. Fisk, chairman of the brick pavements committee and representative of the A. S. M. I. in the A. S. T. M. and the Division of Simplified Practice, reported that the former had slightly revised the form of the existing specifications and suggested a definition of the word "brick"; also had formed a

subcommittee on "Weathering and Porosity." C. D. Pollock, for the stone block committee, reported that no changes in the specifications were thought desirable. H. Eltinge Breed reported that the cement concrete pavement committee is expecting to present next year specifications for quick hardening cements, for accelerating mixtures, and certain other features of recent development. As representative on committees C-1 and C-9 of the A. S. T. M. he reported that the former was revising its standard to agree with the Federal standard; and that the latter expects to adopt the water-cement ratio in its specifications.

F. R. Allen, for the sewer specifications committee, reported that, the committee C-4 of the A. S. T. M. having failed, after years of deliberation, to produce specifications for reinforced concrete pipe, his committee will make an effort to do so this year. E. S. Rankin, representative of committee C-4, reported that that committee is to be combined with C-6, drain pipe.

E. Cameron Corson, for the sidewalk and curb specification committee, reported that the granite block quarrymen and the Hoover committee had almost reached an agreement on specifications for stone curbs, and further details were furnished by C. D. Pollock. J. C. McVea, chairman of the committee on subgrades and foundations, stated that his committee was preparing a tentative specification for subgrades, based on the moisture equivalent theory developed by the Bureau of Public Roads. Mr. Breed said that subgrades seldom gave trouble in cities, but Mr. Pollock cited several cases where they had done so. W. Aldredge, of Winnipeg, stated that he found cross trenches fifty feet apart better than a porous layer to prevent subgrade troubles. Mr. Brockway told of an instance where concrete was laid, and quickly froze, on a frozen subgrade and at once covered with a brick surface and opened to traffic; after several years the pavement is still good, but he did not recommend the practice.

No changes were recommended by the other committees.

F. P. Smith reported that no changes have been made in standard tests of bituminous materials by either the A. S. T. M. or the American Engineering Standards Committee. Julius Adler reported that work of the committee on methods of tests of road materials of the American Engineering Standards Committee was awaiting the final approval of representatives from the A. S. T. M.

Paving.—Victor Nicholson, of the Chicago Dept. of Public Works, described the results of "A Study of European and American Rock Asphalts" and W. J. Doyle, of the Uvalde Rock Asphalt Company, described the use of Uvalde rock. W. H. Rhodes, southern manager of the Asphalt Assn., described, with illustrations and slides, methods of salvaging broken stone and gravel roads by means of different kinds of asphaltic wearing surfaces. H. F. Clemmer, of the Solvay Sales Corporation, brought out forcibly by figures from actual tests the importance of curing concrete bases and of testing concrete on the job, and the effect of temperature, and of moisture of specimen at time of test. A paper entitled "The Value of Brick Pavement to Abutting Property," by W. E. Sheddan, city en-

gineer of Jacksonville, Florida, was read by title in the absence of the author. A paper by Geo. C. Warren discussing "Rigidity vs. Resiliency and Flexibility" was read in the absence of Mr. Warren.

The report of the committee on street maintenance, street cleaning and snow removal is published in full in this issue.

Water Supply.—On Thursday a paper by John R. Baylis giving an excellent resume of "Recent Improvements in Filtration" was read in the absence of Mr. Baylis. This paper we expect to publish in our next issue. Lewis A. Quigley, superintendent of the Fort Worth waterworks, described the results of a water waste survey in that city. About one million gallons per day of leakage within the city was discovered and eliminated, this including mains, services, meters, etc.; and in addition about 1½ million gallons loss in the concrete pipe between the reservoir and the city was discovered and is being remedied by construction of a new and larger line of pipe. A paper entitled "Chlorination of Chicago's Water Supply," by A. E. Gorman, chief sanitary engineer of the Chicago Dept. of Public Works, was read by the secretary, as were the next two papers, the authors being absent, on "Use of Two Mains in a Wide Street" by Thos. F. Wolfe; and "Use of Centrifugally Cast Pipe and Probable Question of Increased Use Relative to Ordinary Cast Pipe" by Lester A. Long. A brief "Summary of Water Works Matters" was presented by John B. Hawley.

Street Lighting.—Prior to his death in September last, C. H. Rust had prepared a quite complete report of the committee on Street and Traffic Lighting, which was read, and was followed by papers on "Street Lighting and the Municipality" by L. A. S. Wood; and on "Speed and Safety with Traffic Control and Light" by A. F. Dickerson, both of which were illustrated by lantern. These will be published by, and can be obtained from the Westinghouse Electric and Mfg. Company and the General Electric Company, respectively.

Sewerage.—In a paper entitled "Economic Aspects of the Activated Sludge Process," Robert Cramer, chief engineer of the Milwaukee Sewerage Commission, and J. A. Wilson, consulting chemist, gave in detail figures from the first year's operation of the Milwaukee plant. This paper will be published in a later issue and is of unusual interest. This plant makes and sells an average of 90 tons of fertilizer a day, and has a market for all it can produce. This yielded last year \$442,000 net; but the operation of the plant cost \$950,000, including repairs, insurance etc., but not interest or depreciation on construction cost. The plant treats 86,000,000 gallons of sewage daily its capacity, but the city already produces more sewage than that. The biological oxygen demand of the effluent varies from 0 to 6 p.p.m. Jerry Donahue described the results of gas collection at the sludge digestion plant at Antigo (described in PUBLIC WORKS a few months ago). He estimated that fuel necessary to do all the work done by this gas in heating the digestion tanks and the building would cost \$400 a year. The sewage is contributed by about 6,500 persons.

Street Maintenance, Street Cleaning and Snow Removal

Report of Committee at the Annual Convention of the American Society for Municipal Improvements.

Data collected during the past year from several hundred cities of all sizes and in all sections of the country by PUBLIC WORKS, of which the chairman of this Committee is Editor, show that the majority of cities, even those of 20,000 population and less, use street cleaning machinery, and that it is used by practically all cities of over 100,000 population.

In those under 20,000, flushing machines lead in number, horse-drawn machine brooms are used by about 80 per cent as many, pick-up sweepers by about 40 per cent as many, but only a few use motor-driven brooms without a pick-up attachment. However, purchases made during recent years by these small cities show that as many of them have purchased pick-up sweepers as have purchased flushing machines and motor-driven brooms combined. Almost no horse-drawn brooms are being purchased.

In cities of between 20,000 and 100,000 population, pick-up sweepers lead as to both number in use and recent purchases, equalling the combined number of all other equipment in use and exceeding by 50 per cent all other kinds purchased.

In cities of more than 100,000, flushing machines lead, being found in 90 per cent of them; while horse-drawn brooms are used by about half of them, as are also either machine brooms or pick-up sweepers. Of machinery recently purchased, pick-up sweepers lead, with flushing machines second, and vacuum sweepers third. Motor-driven brooms other than pick-up seem to find favor in few cities of any size, some cities at present abandoning them for horse-drawn sweepers.

The keeping of records of cleaning, by large cities especially, is increasing and the records are becoming more valuable. This is as it should be, for if we do not know the unit cost of present service, how can we tell whether changes intended to increase efficiency and reduce cost actually do so? At the convention held by this society in Dallas fifteen years ago, a committee of which the chairman of this committee was chairman, made its first report on standard forms for public utilities, and at a following convention recommended a set of forms for street cleaning and refuse disposal. Apparently this action was ahead of the times and undoubtedly the forms could now be improved upon to meet present conditions and ideas. It seems to your committee that it would be desirable to ask a number of street cleaning officials who now keep such records to form a committee and prepare a form for general use which will permit each city to compare the rela-

tive efficiencies of its present and future methods, machinery and men, and also to make reasonably satisfactory comparisons of its own costs with those of other cities.

The equipment available for collection refuse is increasing each year in diversity and excellence, as manufacturers compete with each other; but it still must be said that few, if any, superintendents are thoroughly satisfied with their equipment and methods. While the amount paid for collection is generally two or three times that of disposal, the handling of both garbage and ashes is objectionable to citizens in front of whose premises or person the loading is performed and past whose homes the wagons travel; and the household garbage pail is generally the most foul appearing and smelling object on the premises. Although, as stated, the present cost of collection is high, we believe that the citizens would commend an official who would increase this cost if, by doing so, he improved these conditions. This is one of the few municipal functions which affect every housewife personally and intimately, and improvement in it would instantly be recognized.

The unsatisfactory conditions are due, we believe, as much to the personnel as to the equipment and methods. But we cannot expect to greatly improve the former unless we improve the latter; until the work that we ask collectors to do can be performed in a uniform without disgracing it, we cannot expect men to wear the uniform who are not a disgrace to it. A Colonel Waring—an engineer with an appreciation of the importance of his work, a practical idea of how present methods can be revolutionized, and the force to put it over, disregarding the opposition of both taxpayers and politicians until results compel their approval,—such a man, taking charge of refuse collection in one of our large cities, could, we believe, and will before long, we hope, show us how to greatly improve the performance of that municipal duty which is now at least satisfactorily performed.

Pail collection, in wagons completely enclosed, of inconspicuous appearance and noiseless, the pails to be thoroughly cleaned where emptied, and redistributed for use; the collectors to be in uniforms that need not be soiled by the work imposed; some such system is suggested as a great improvement over present practice in most cities, and one the practicability of which has been demonstrated by the approximations to it in several cities.

In the disposal of garbage the present tendency is toward incineration, rather than to hog feeding or reduction; and toward medium-cost incinerators rather than high-cost destructors or low cost plants of the Dutch oven type. However, a few cities have recently installed destructors and quite a number of the simple low-cost type. The medium cost plants generally provide for drying the garbage (as on a drying hearth) as a preliminary to burning, and for destroying odors before the gases reach the stack.

In refuse disposal as well as in street cleaning, the collection and recording of facts and figures in a form permitting of comparisons is desirable. At present it is too commonly the practice, in planning collection or disposal methods and systems, to use general figures collected in other places and

in other years. But we believe the amount and composition of garbage varies from place to place and from time to time more than is generally realized. The per capita amount decreased during the war and increased after; has been found to be less in the poorer districts of Chicago, Boston and other cities than in the wealthier districts, and it is therefore probable that it is less in hard times than in prosperous ones and that this variation will be greatest in the poorest sections. The character as to proportion of fat and edible matter in garbage also changes with the wealth of the district; and the geographical differences of location also are reflected in the composition of garbage.

Differences in both amount and composition of rubbish also are found, due to differences as to local and general prosperity and geographical location. Unfortunately there are few definite or continuous records which permit determination on these points of sufficient exactness to be of any practical use.

Refuse Collection and Disposal in Chicago

The cost of removing ashes in Chicago decreased 5 cents per cubic yard in 1926, as compared to 1925. The tractor and trailer system operated in 1926 in 35 out of 50 wards and this service is now effective for 80 per cent of the city on garbage collection, and 70 per cent on ashes and miscellaneous waste. The total number of tractors owned is 150, of which 118 were added during 1926; 855 trailers are in use, of which 430 were added in 1926.

Garbage service by tractor and trailer over a period of only five months effected a saving of 31 cents per ton on the year's cost. During 1926, collecting garbage and delivering it to the Municipal Reduction plants cost \$6.36 per ton. Collection and disposal of ashes cost \$1.08 per cubic yard.

The total amount of raw garbage received at the Municipal Reduction plant aggregated 102,364 tons, an increase of 459 tons as compared with the previous year; 5,881,060 pounds of garbage grease were produced during the year, a decrease of 121,100 pounds as compared with the year 1925. The sale of garbage grease and tankage during the year 1926, together with the revenue derived from the sale of rags and scrap iron, produced a total revenue of \$392,500.97, a decrease of \$2,002.77 as compared with the year 1925. The expense of operation amounted to \$734,758.45. With the inventory considered, the net cost of operation was therefore \$347,343.98, which means an increase in net operating expense of \$34,259.71. This is accounted for by reductions in the market value of garbage grease and by increases in salaries and wages to employees of the plant.

Garbage grease produced a revenue in 1926 of \$3.64 per ton of raw garbage; tankage revenue amounted to 18.4 cents, rag revenue to 0.66 cents, and scrap iron to 0.47 cents per ton of raw garbage. The total revenue per ton of garbage amounted to \$3.84. The unit cost of operation per ton of raw garbage during 1926 amounted to \$7.178, of which \$4.517 was for salaries and wages; 72.9 cents for fuel oil; 17.7 cents for power and light; 42.6 cents for coal; \$1.051 for supplies and repairs; and 27.8 cents for the removal of dried garbage and rubbish.

NEWS OF THE SOCIETIES

Jan. 9-10—INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS. Annual convention at Detroit, Mich.

Jan. 9-14—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual convention and road show at Cleveland, O.

Jan. 19-21—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting at New York City.

Jan. 23-27—ASSOCIATED GENERAL CONTRACTORS. Annual convention at West Baden, Ind.

Feb. 3—NEW JERSEY STATE LEAGUE OF MUNICIPALITIES. Annual Meeting at Trenton, N. J.

Feb. 21-24—SOUTHWEST ROAD SHOW AND SCHOOL. Wichita, Kansas.

Feb. 28-March 1—AMERICAN CONCRETE INSTITUTE. Annual meeting at Philadelphia, Pa.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS.

The thirty-third annual convention was held at Dallas, Texas, November 14 to 17. The total registration was about 250, of which 125 were from sections outside the state of Texas, extending from Canada to Florida and west to California. Although the attendance was small, the convention was generally considered to be a most successful and enjoyable one.

The only business of importance that was transacted was the adoption of a resolution to submit to letter ballot a change in the constitution providing for a new class of membership, to be known as "Senior Member," consisting of those active members who have paid dues continuously for 30 years; such members to be relieved of the payment of any dues. Six members are now eligible. Also a committee was appointed, to report next year, suggestions for changes in the conduct of the society calculated to enable it more effectively to perform the functions for which it was organized.

The officers elected for the ensuing year were as follows: For president, George F. Fisk, of Buffalo, New York; 1st vice-president, John Klorer, New Orleans; 2nd vice-president, P. L. Brockway, Wichita, Kansas; 3rd vice-president, J. W. Reid, Detroit; treasurer, S. Cameron Corson, Norristown, Pa. C. W. S. Sammelman of St. Louis was reappointed secretary.

Detroit was selected by the executive committee as the place for the next convention; the date to be decided upon later.

All meetings began promptly and adhered to the program, except that two papers were postponed from Wednesday morning to the next session. However, the authors of about half of papers scheduled were not present, the papers being read by others; on account of this there was an unusually small amount of discussion. Abstracts of papers and discussions will be found in another part of this issue.

The entertainment features were unusually generous. The Citizens and Technical Club of Dallas gave a dinner to members and guests on Monday; a dance on Tuesday and a banquet on

Thursday, and the citizens and Technical Club of Fort Worth gave a ride around that city and a dinner on Wednesday; the Trinity Portland Cement Company gave a lunch at its plant on Tuesday; and the Texas Company presented prizes for a golf tournament. The visiting ladies were kept pleasantly occupied during the convention.

About thirty new members joined the society during the year and at the convention. The treasurer reported about \$1700 on hand with all debts paid.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The Fiftieth Anniversary of The American Society of Mechanical Engineers will be celebrated during the week beginning April 7, 1930. This date marks the anniversary of the organization meeting of the society, which was held at Stevens Institute of Technology.

While plans for the proposed celebration have not been entirely completed, the tentative arrangement provides concurrently for an international engineering congress of outstanding nature which will not only mark the achievements of the engineering profession for the past fifty years, but will point the way for future growth and development.

It is expected that this Fiftieth Anniversary Meeting will be held in Washington, D. C., thus giving it a national and international character.

AMERICAN ROAD BUILDERS' ASSOCIATION

All previous conventions will be eclipsed on January 9, which marks the beginning of the twenty-fifth annual convention and Road Show. The great development and progress made during the past year, together with the greater exhibition facilities, will make it possible for this Convention and Road Show to surpass all previous ones. The special efforts made by the Program Committee and the numerous requests by exhibitors for exhibition space are indicative of the demand by the road-building industry for a convention where the latest developed equipment and most up-to-date methods may be seen and described and offered for the general education of those interested in highway work.

The program will open with general subjects, after which special sessions will be held for both contractors and engineers. On Pan American Day a general program of the road industry and conditions throughout the Western Hemisphere will be of interest to all. In addition to this, special programs are being held for different divisions.

Tuesday, January 10th, will be Governors' Day. Governor A. V. Donahey of Ohio, will be Honorary Chairman of the day.

Wednesday, January 11th, will be Pan-American Day and the program is given over to the special problems important in all countries, as well as the development of closer relations with the Pan-American countries, especially in regard to their highway programs. Dr. E. Gil Borges, Assistant Director of the Pan-American Union, is Chairman of Pan-American Day and closer identification with the Pan American countries assures the greatest success for this day.

Thursday, January 12th, is County Highway Officials' Day. The newly-organized Division, under its President, Thomas J. Wasser, will have charge of the program for this day. The County Division is functioning through eight Standards Committees, covering the county highway problems. Papers and reports of these committees will constitute the program of this day and all activities will be carried on by county officials.

Friday, January 13th, will be given over entirely to the Road Show, so that engineers, officials and contractors who have devoted their time to listening to the papers at the Convention will have an opportunity to visit the Road Show and inspect and compare the latest development in equipment and materials.

COMING MEETINGS OF LOCAL SECTIONS OF AMERICAN WATER WORKS ASSOCIATION.

The next meeting of the Kentucky-Tennessee Section will be held at the Kentucky Hotel, Louisville, Ky., January 19th, 20th, and 21st, 1928. F. C. Dugan, State Board of Health, 532 W. Main Street, Louisville, Ky., is Secretary.

The Montana Section will hold its next meeting at Lewiston, Mont., March 8th, 9th, and 10th, 1928. H. B. Foote, Director Division of Water and Sewage, State Board of Health, Helena, Mont., is Secretary.

The next meeting of the Rocky Mountain Section will be held February 23rd and 24th, 1928, at Denver, Colo., and February 25th, 1928 at Pueblo, Colo. Dana E. Kepner, State Board of Health, 420 State Office Building, Denver, Colo., is Secretary.

HOUSING AT ROAD SHOW.

The American Road Builders' Association has announced that all visitors at the road show can be taken care of. The housing bureau will continue to function until the middle of Road Show Week. Visitors can be assigned directly to rooms by this bureau, without the necessity of visiting hotels in search of vacant rooms.

PERSONALS

Redmond S. Colnon, president of the Fruin-Colnon Contracting Co., St. Louis, died Oct. 9, aged 65 years. An engineering graduate of Cornell, he en-

tered the contracting business in 1895. One of his latest contracts was on the St. Louis water works at Chain of Rocks.

W. S. Shields, J. G. Jordan and Frank C. Roe have formed a partnership as sanitary, hydraulic and electrical engineers under the name of Shields, Jordan & Roe, with offices at 8 South Dearborn St., Chicago.

C. M. Baker has resigned as state sanitary engineer of Wisconsin, to become associated with the engineering staff of the American Paper and Pulp Association of New York. He is succeeded by L. F. Warrick, formerly assistant state sanitary engineer.

Professor S. S. Steinberg, Head of the Department of Civil Engineering at the University of Maryland, has resigned as Assistant Director of the Highway Research Board, National Research Council.

Gustave A. M. Liljencrantz, for forty-seven years employed on river and harbor improvement work throughout the great lakes region, died recently in Stockholm, Sweden, aged 85. Mr. Liljencrantz was a graduate of the Royal Technical institute at Stockholm. He came to the United States in 1869 and became associated with the army engineering service, first at Milwaukee, and in 1870 was assigned to the Chicago office where he served with distinction under many chief army engineers for the corps area.

BOOK REVIEW

The Microscopy of Drinking Water. By George C. Whipple. Revised by Gordon M. Fair, Assistant Professor of Sanitary Engineering, and Melville C. Whipple, Assistant Professor of Sanitary Chemistry, Harvard University. 4th Edition. 586 pages; 19 colored plates. John Wiley & Sons, Inc.

The fourth edition of this book is a revised, rewritten and enlarged version of a volume with which sanitary and waterworks engineers and chemists have been familiar for nearly 30 years. The changes made by the revisers have served to place in easily usable form a large amount of recent information gained from the study of microscopic organisms in water, their relationships and habits, and the methods of controlling them.

Part I, dealing with "Applied Microscopy," has been entirely rewritten, and the material is presented in a serviceable and useful manner. Chapters dealing with the methods and purposes of sanitary water analyses, the control of algae, "Rheology," and the self-purification of streams are essentially or entirely new; other chapters in Part I treat of tastes and odors, collection and examination of samples, records of examinations, Limnology, and storage of water.

Part II, which treats of "Determinative Microscopy," classifies and identifies in a systematic manner the various organisms. An important addition to this

section is the "Ecological Classification of Microscopic Organisms," which lists a large number of aquatic organisms, identified as to their preferred environment.

CIVIL SERVICE EXAMINATIONS

Engineer, Associate Engineer, Assistant Engineer.—Application to Dec. 13, to fill vacancies with Interstate Commerce Commission. Non-assembled examinations in civil, electrical, mechanical and signal engineering. Entrance salaries, \$3,800, \$3,000, and \$2,400, respectively.

Junior Cartographic Engineer.—Applications to Dec. 6 to fill vacancies in Coast and Geodetic Survey. Work consists in the utilization of data in the compilation and correction of nautical charts. Entrance salary, \$1,860.

TRADE PUBLICATIONS

Anniversary Number, du Pont Magazine. 52 pp. Ill. E. I. du Pont de Nemours & Co., Wilmington, Del. The anniversary number of the Du Pont Magazine commemorates the founding of that company 125 years ago and recounts the advances in science and in the chemical field during that period. Interesting chapters are: Black Powder History; Old Black Powder Days; High Spots of du Pont High Explosives History; Development of Military Powders; Coated Textiles; du Pont Engineering; Science and Paint; Dye-stuffs; Textiles; Motion Pictures; Cellophane; Employee-Employer Relations.

Concrete, Its Manufacture and Use. Fifth Edition; 204 pp.; 27 illus. The Koehring Company.

As stated in the preface, this is a "book of reference of sound engineering practice, in concise and readable form." Its fifteen chapters cover a wide range of subjects, including field operations, materials, highway construction, notes for superintendents and foremen, forms, reinforcing, specifications, estimates and cost, culverts and bridges, foundations, waterproofing, submarine concreting, and care and operation of mechanical equipment. Engineers will find "Concrete" to be a most useful and convenient handbook of information. It will be sent free on application.

Butler Weighing Hoppers, 12 pp.; Ill. The Butler Bin Co., Waukesha, Wis. This bulletin, No. 150, describes in detail the method of proportioning aggregates by weight.

Novo Pumping Handbook. Novo Engine Co., Lansing, Mich. 40 pp. Ill.

Many valuable tables are included in this book, which contains many data about pumps and pumping. Drawings and photographs of installations accompany the descriptions, and furnish information of much practical use.

Snow Plows, La Plante-Choate Mfg. Co., Cedar Rapids, Ia. 20 pp. Ill. This booklet gives valuable data regarding snow plow design and construction; and also much information on snow handling and removal from country roads and city streets. The entire La Plante-Choate line is illustrated and described.

Concrete Pipe Sewers. 32 pp.; Ill. The American Concrete Pipe Association, Chicago. This booklet gives much interesting information on the development of sanitary engineering. The manufacture of concrete pipe is discussed in detail, and its advantages pointed out. Examples of the use of concrete pipe in many cities are given.

INDUSTRIAL NOTES

CONNERY & CO. EXPANDS PLANT

Connery & Co., Philadelphia, Pa., has just completed a 2-story plant extension and office, adding 35,000 square feet to its present plant. This plant will be devoted exclusively to the manufacture of tar and asphalt heating kettles, breechings, uptakes and air and pre-heater ducts, using the Connery Improved Expansion Stiffener.

MACK "ROAD COURTESY" SIGNS.

The Advertising Department, Mack Trucks, Inc., New York, are furnishing upon request gummed strips suitable for attachment to windshields. These strips read: "THIS DRIVER WILL MEET ALL OTHER GENTLEMEN HALF WAY ON ANY TRAFFIC SITUATION."

AURORA PUMP CO.

The Aurora Pump Co. of Aurora, Ill., has purchased the business of the Aurora Pump and Manufacturing Co. and will continue to specialize in the manufacture of centrifugal pumps and deep well turbines of high efficiency. L. W. Bodinson is chief engineer, and C. G. Walters, superintendent.

PECK IS THEW VICE-PRESIDENT

Frank A. Peck, vice-president of the Universal Crane Co., has been elected vice-president of the Thew Shovel Co., Lorain, O. These two companies are closely affiliated and Mr. Peck will be active in the management of each of them. He has had a wide experience in the crane and shovel field, and for many years has been a director of the Thew Shovel Co.

SEPTEMBER INDIANA TRUCK SALES

Orders for Indiana Trucks entered during the month of September by the Indiana Truck Corporation, Marion, Indiana, show an increase of 41% over the orders received in September, 1926. Indiana third quarter sales this year show a 35% increase over their third quarter business of last year. This is on top of similar gains made during the first half of this year over last year.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

A NEW STUMP PULLER

Boone & Wester, Contractors, Cedar Key, Fla., have perfected an improved stump puller which has been used successfully in clearing and grubbing rights-of-way on three state aid projects in Florida. The puller, which weighs about 1600 pounds, is made from two pieces of 6 x 6 iron, hinged at one end so as to open and close like a nutcracker. On these jobs, the power for pulling the stumps was supplied by several P. & H. cranes, the puller being swung from the point of the boom by the hoisting cable, while the stump is pulled by the drag-line cable. The larger stumps are first loosened or split with explosive, thus speeding the pulling and the subsequent burning. The entire operation is performed by two or three men. No hand work is required to fasten the puller to the stump nor to release the stump when in position to drop. Because of the arrangement of the cables, the harder the pull, the tighter is the grip on the stump.

It is stated that two to five acres of stumps can be pulled per day, depending on the character of the ground, and the number of stumps to be pulled. An advantage of this method is that the roots are pulled out, thus removing these obstructions to grading and eliminating perishable matter from the soil.

While used so far principally on road right-of-way clearing, the puller is applicable to any kind of land clearing, including reservoirs for water supply or power, dam sites, levee construction and agriculture developments.

A. B. C. ASPHALT BRICK FOR BRIDGE AND INDUSTRIAL FLOORS

The Asphalt Brick Co., St. Louis, Mo., has perfected a brick made from rock asphalt, and has higher penetration and melting points than artificially mixed asphalts, it is said. Among the advantages claimed are long wear, waterproofness, low cost, and resiliency. It is non-skid, impervious to mild acids and

alkalies, will not rut or push ahead of the wheels, and can be laid without special tools, only a hammer and chisel being required. Traffic welds the joints together, forming a tight waterproof surface. A. B. C. brick may be laid on a wood, concrete, or other firm sub-base.

Because of the relatively light weight and long wearing and non-skid properties, these brick are especially suited for bridge floors.

VULCANITE SUPER CEMENT

The Vulcanite Portland Cement Co., New York, manufactures Super Cement, which is said to be a more efficient form of Portland cement, particularly adapted to construction requiring impervious concrete. Its colloidal action and hydration are considerably greater than Portland cement. No claim is made that it is of greater strength in earlier periods, but it will be, in general, somewhat stronger at all periods. Super Cement is very much more workable, producing maxi-



STUMP PULLER IN OPERATION IN FLORIDA. INSERT, CLOSE-UP OF "NUT CRACKER" STUMP PULLER



A.B.C. ASPHALT BRICK ON BRIDGE FLOOR

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mum density, and is claimed to be absolutely waterproof and oilproof.

Super Cement is made from the same clinker as that used in the manufacture of Vulcanite Portland cement; a small percentage of a special grade of tannin; produced from oak gall nuts, results in greater hydration and colloidal action. Super Cement slides freely in chutes, without lubrication and without segregation; it settles around reinforcing without puddling; floor finishing may be carried on up to the final set, which occurs as in ordinary cement. In sewage treatment plants, no waterproofing or protection is required; and it is said to be proof against alkali waters and sewer gas.

ROOT REVERSIBLE SPRING SCRAPER.

The Root Spring Scraper Co., Kalamazoo, Mich., manufactures the Root Reversible Spring Scraper, which it is claimed, will do all the work required in building and maintaining dirt and gravel roads, at less cost and with a smaller investment, as it does away with the necessity of much expensive machinery. Blades, in either 5-16 or $\frac{3}{8}$ -inch thickness, and in 9 and 10-foot lengths, are dressed on both sides. The scraper may be set at any angle; and the gear ratio of 3:1 supplies sufficient leverage to raise the rear wheels of the truck off the ground. The construction is such as to permit two trucks, traveling side by side in the same direction, scrapers set at opposite angles, to dress the entire surface of the road. Root scraper blades are made to fit all graders.

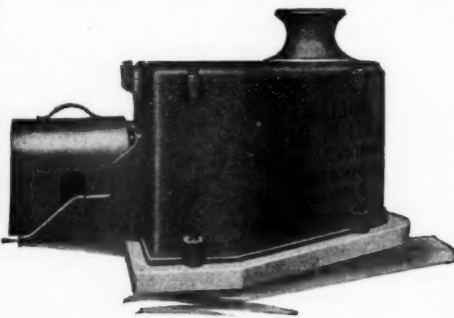
NEW SULLIVAN "T-3" WATER DRIFTER

The Sullivan Machinery Co., Chicago, Ill., has brought out a new Water Hammer Drill, the "T-3," which is suited to drifting or tripod work in mining, quarrying, and contracting service, such as tunnels, shafts, or open cut excavations. The "T-3" will drill 14-foot holes for $\frac{1}{4}$ -inch powder readily, and under favorable conditions will go much deeper. The machine with a 30-inch shell weighs 156 pounds, but shells of 24 or 36-inch feed also are supplied. Automatic lubrication in the drill itself is supplemented by the use of an automatic line oiler in

the air line leading to the drill. Advantages of the "T-3" are stated to include high drilling speed, smooth operation, freedom from vibration, and economy.

GALION CAR PULLER

The Galion Iron Works and Mfg. Co., Galion, O., has just placed on the market a new and powerful car puller which provides a practical and inexpensive means of moving and spotting cars. This device, an adjunct of the Galion Skip Hoist and the Galion Mono-Veyor, can be supplied with a 5, $7\frac{1}{2}$ or 10 horsepower electric motor, as desired. Gear reduction is by means of machine cut steel gears running in a bath of oil in a dust-proof cast-iron housing of heavy construction. The



GALION CAR LOADER

capstan is vertical, as this type permits pulling in any direction. All working parts are enclosed, and a weather-proof sheet metal housing protects the motor.

THE DUREX PUMP

C. I. Longenecker of Milwaukee, Wisc., has just put on the market a new pump, built on the automotive principle, which is called the Durex. It has all the working parts completely enclosed. A separate oil pump supplies oil to the working parts of the pump.

The mounting of the Durex is unique in that it is equipped with springs and has knuckle type front axle. A spring

draw bar with a heavy eyebolt also is furnished. The power furnished is a thirty-five horsepower heavy-duty Waukesha motor. A twin disc clutch is mounted between the engine and pump which permits easier starting.

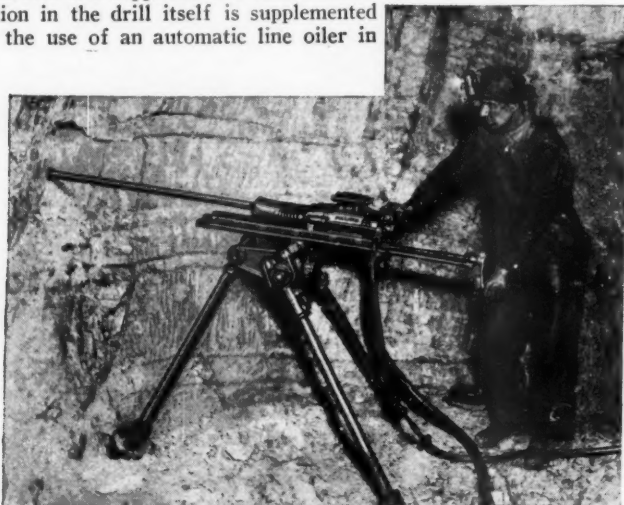
The pump is built to supply the demand of contractors who want machinery that will give the maximum service with the least possible maintenance and up-keep cost. With a separate oil pump in the engine and pump, the Durex owner has assurance that his pump is constantly lubricated.

It supplies sufficient water for a 27-E paver. Its capacity is eighty gallons per minute or 4,800 gallons per hour at any pressure up to 500 pounds. Besides road work, this machine can also be used for well point and other similar work.

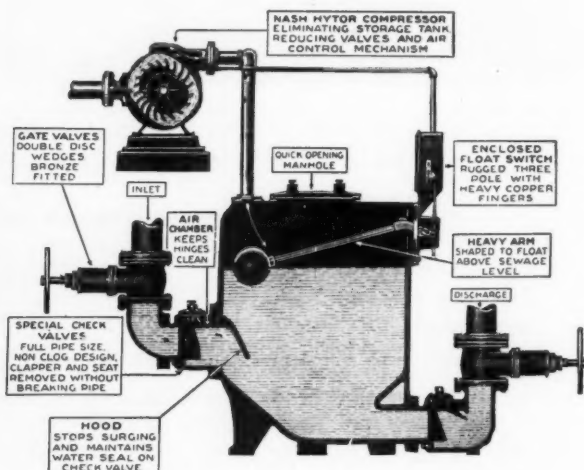
JENNINGS SEWAGE EJECTOR.

The Nash Engineering Co., South Norwalk, Conn., manufactures the Jennings Sewage Ejector, which is used by a number of municipalities. This pneumatic ejector is claimed to be able to pump any material which will flow through the inlet pipe, without screening or separation. It has no submerged, inaccessible working parts in contact with grit or dirt. Discharge is from the bottom, preventing the collection of sediment. It adapts itself automatically to the rate of flow, eliminating large and expensive storage basins; air is supplied only when sewage is actually being pumped, no high-pressure air being required or stored. The Nash Hy-Tor compressor furnishes air under pressure to the ejector when discharging the pot; when the pot is filling, and the compressor is at rest, air displaced by the incoming sewage passes through the compressor to the vent. The compressor consists of a single revolving rotor running without contact in its casing.

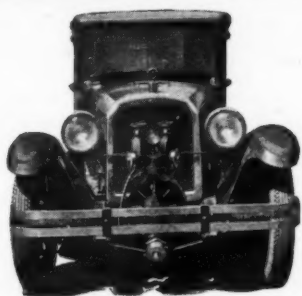
The Jennings ejector is made in standard sizes for single installations with capacities of 50 to 300 g.p.m.; and for duplex installations up to 600 g.p.m. Bulletin No. 67 describes this ejector.



SULLIVAN "T-3" WATER DRIFTER



JENNINGS SEWAGE EJECTOR



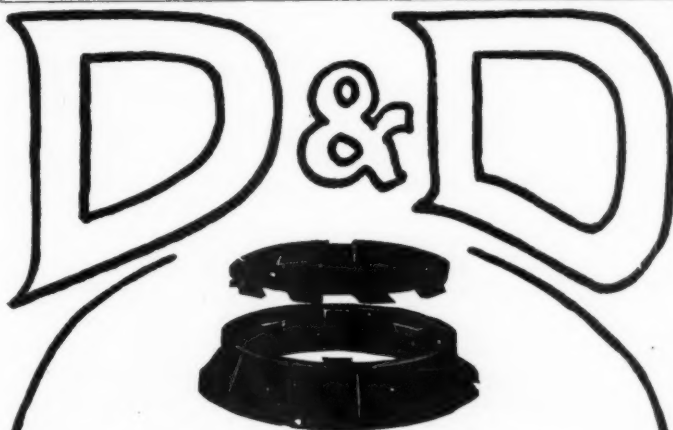
NEW

MANY startling improvements are incorporated into this new Barton Fire Pump. It delivers plenty of water at pressures up to 200 pounds. It drives direct from your car or truck engine (all makes). It primes itself automatically. It takes water from any available source—under hydrant pressure or at suction. It offers adequate fire protection to any community—with a very nominal investment. Write today for our Announcement Bulletin, giving complete information and showing interesting pictures of the Barton in action.

AMERICAN STEAM PUMP COMPANY
BATTLE CREEK, MICHIGAN

BARTON

New FIRE PUMP



SAFETY and NOISELESS Manhole Cover

Does away with rattling or dishing

Our foundries and machine shops are equipped to handle work on a production scale. No order too large or small.

A large stock of stock patterns on hand and prompt deliveries assured. Special castings of soft gray iron from drawings or blueprints. We can also machine any castings to size.

Full particulars on request—send for catalogue.

WM. E. DEE COMPANY

30 N. La Salle Street

Chicago, Ill.

Manhole, Catch Basin and Sewerage Castings of All Kinds. We Make Anything in Gray Iron
Write for Our Prices



Bury that small stream in an ARMCO culvert

SMALL streams often cause trouble and expense far out of proportion to their size. They endanger embankments, disfigure valuable land, or in cities may even be both an unsanitary eyesore and an actual menace to the community.

A simple way to end the matter is to place an Armco Corrugated Pipe of suitable size in the bottom of the stream and cover the pipe with filling material. The space above the stream is then available for use, in some cases a road may be placed along the stream. In any case the expense and menace of the stream are permanently eliminated.

Engineers and municipal officials are finding Armco Corrugated Pipe of great value for storm sewer systems, for cross drains, for small bridges and similar drainage uses. An interesting booklet "12 Helps to Better Drainage for Cities" mailed on request.

Armco Culvert Manufacturers' Association
Middletown, Ohio

Forty manufacturing plants throughout the United States and Canada assure you immediate service on drainage requirements, no matter where you may be.

ARMCO CULVERTS

*Predominant in use—because
predominant in quality*

1928 CONVENTION AND ROAD SHOW
AMERICAN ROAD BUILDERS ASSN.
JANUARY 9TH-13TH INCLUSIVE
CLEVELAND, O.
Space No. EH-41



© 1927, Armco Culvert Mfrs.

Assn., Middletown, Ohio

SIMONS PAINT SPRAY BRUSH

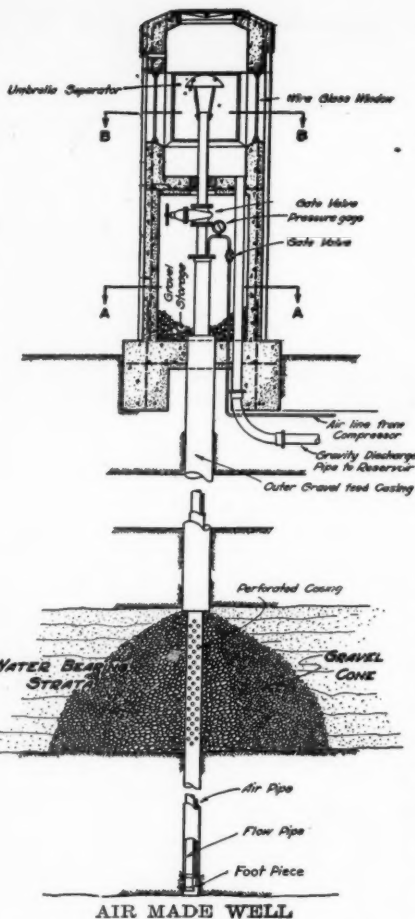
The Simons Paint Spray Brush Co., Dayton, O., has developed a spray gun for painting, which operates at a very low pressure, thus enabling the operator to have complete control of the disposition of the paint. This gun will do the work of three or four men, and, it is claimed, will save about 30 per cent. of the paint. It is of especial advantage in painting bridges, standpipes, elevated tanks, machinery, municipal buildings and motor vehicles. When used with kerosene and about 70 pounds air pressure, it is especially handy for cleaning motors, engines, machinery and equipment prior to painting. The Simons Paint Spray Brush Co. also manufactures an oil and water separator, which is claimed to eliminate troubles due to oil and condensed water passing through the air line.

SUPER-SEPTIC TANKS

The Super Septic Tank & Engineering Corp., Buffalo, N. Y., has brought out a line of large septic tanks which are designed for use at institutions, homes, clubs, factories, and other places outside of the sewered districts. The larger tanks are made in capacities of 1,075 to 26,000 gallons, but smaller tanks are available with capacities as little as 200 gallons. The large tanks, which are made of copper-bearing steel or iron, 1/4 to 5/16 inch thick depending on the size, are of the horizontal type. Various combinations of width and length are available, so that space requirements can be met. All tanks have inspection openings over intake and outlet; tanks up to 12 feet have one 16-inch manhole and larger tanks have two or more manholes.

BARTON FIRE PUMP.

The American Steam Pump Co., Battle Creek, Mich., has developed the new Barton fire pump type C-1, which is especially designed to provide fire protection for the small community, village,



suburban district, park, resort or institution not having a water supply system. It also can be used as a booster, taking water at hydrant pressure and raising it to a maximum of about 200 pounds. The pump is attached to the front of the frame of an automobile or truck, and takes power from the engine. It is a cheap and valuable form of fire protection for communities unable to invest in complete fire-fighting apparatus.

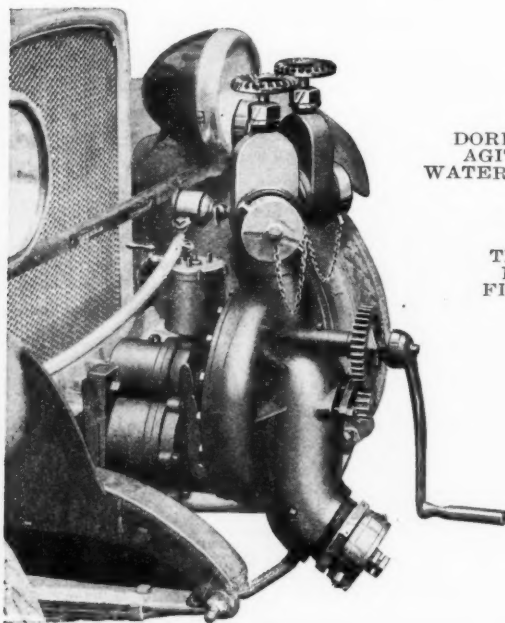
AIR MADE WELLS.

The Air Made Well Co., Oklahoma City, Okla., is an organization composed of engineers and geologists who, in connection with the Air Lift Department of the Sullivan Machinery Co., Chicago, Ill., specialize in the treatment and restoration of wells in sand or silt formations. The fine sand which packs around the screen cuts off the flow of water. The Air Made Well Co. pumps out the sand and replaces it with coarse gravel, and this process is continuous throughout the life of the well, which thus has a tendency to increase in yield. The Sullivan Air Lift pumping system is used, eliminating troubles from varying water levels, crooked wells, and cutting of sand.

DORR IMPELLER AGITATOR FOR WATER TREATMENT.

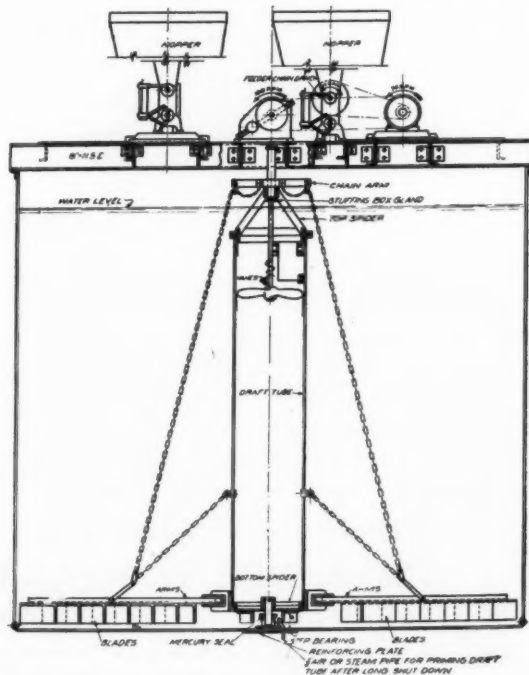
The Dorr Co., New York, has just brought out the Dorr Impeller Agitator, which is the most recent equipment development of the Dorr Company in the water works field. This unit is designed to furnish the efficient mixing, important in softening hard waters and dosing turbid waters. A feature of considerable importance is its ability to turn over a large volume of water at a velocity which does not break up flocs.

The tank contents are circulated through a centrally-located cylindrical draft tube in which a marine propeller is rotated. The draft tube, which revolves slowly, is supplied at its lower end with a pair of radial arms equipped with plow blades. The tank contents are given a general circulating movement in both the horizontal and vertical planes, which results in a high rate of change of position of the various particles in the water being treated. The water travels first, upward through the draft tube; second, radially outward just below the surface; third, down through the annular space between the draft tube and tank;



RIGHT
DORR IMPELLER
AGITATOR FOR
WATER TREATMENT

LEFT
THE NEW
BARTON
FIRE PUMP



HIGH GRADE WATERWORKS SUPPLIES

Specialties of the Highest Grade

THE SMITH VALVE INSERTING MACHINE

The Latest and Most Important Tool Devised to Aid Water or Gas Departments

This machine will cut section of pipe, place required size valve in position, complete the work in every detail and all done without any interruptions to supply.

Write us and we will make you a proposition, either on purchase of machine or on a rental basis.

We guarantee to insert all sizes from 4" to 24", inclusive, without shutting off supply.



THE SMITH TAPPING MACHINE



This Machine Will Make Connections to Any Size Mains Without Shutting Off the Supply

1. It saves danger from fire when supply is off.
2. It saves annoyances to consumers.
3. It saves shutting down to set new hydrants.
4. It saves outlay of money for specials which may never be used.
5. It saves working at night to cut in old way.
6. It saves worry and anxiety to superintendent.
7. It saves money by having insurance rates reduced.
8. It saves its cost in a short time.

Makers of Smith Tapping Machine, Valves, Lead Furnaces, Pipe Cutting Machines, Gate Valves and Other Water Works Specialties

WRITE FOR CATALOGUE

The A. P. Smith Co.
East Orange, N. J.

HOTEL FLANDERS

Just East of Broadway
133-135 West 47th Street
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A modern high-class 15-story hotel very close to Times Square and within a few minutes to all leading Theatres and Shops.

Room with running water \$2

Room with bath \$2.50 up

Special rates for long or short periods

FRED W. BIZEL, Res. Mgr.

CEMENT LINED SERVICE PIPE

Guaranteed Against Injury From Handling. Standard Fittings With Special Shaped Lining That Makes Perfect Joints.

CEMENT LINED PIPE COMPANY
LYNN, MASS.



Style "RA1"

EDSON DIAPHRAGM PUMP SPECIALTIES

Hand, Gasoline and Electric Outfits

LIGHT PORTABLE and HEAVY DUTY 3-inch or 4-inch PUMP UNITS

Originators and Manufacturers of EDSON Quality PUMPS, Special SUCTION HOSE, Red Seal DIAPHRAGM with Bead, other Accessories

Write for Catalogue T

EDSON MANUFACTURING CORP.

NEW YORK

142 Raymond St., Brooklyn

Main Office and Works

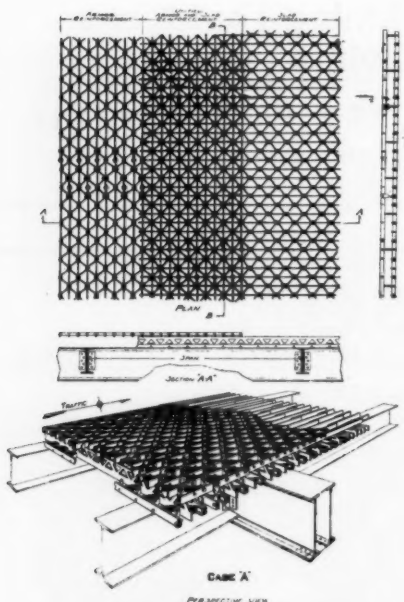
375 Broadway, BOSTON, MASS.

and fourth, radially inward to the base of the draft tube. It is the function of the slowly revolving rake arms to keep the bottom of the tank free from settled solids at all times and to serve as a means of moving such particles as do settle to a point under the draft tube where the sucking action of the propeller may elevate them to the surface and return them to circulation.

Turn over, or the time required to completely circulate the tank contents, may be varied to suit the particular requirements of each problem and usually ranges from one to eight minutes. By varying the diameter of the draft tube and the propeller characteristics, velocity may be varied to suit the requirements of different types of treatment. This agitator is expected also to find a wide application at plants where industrial wastes are treated chemically before sedimentation in mechanical clarifiers.

IRVING UNIFIED REINFORCEMENT AND SURFACE ARMOR

The Irving Iron Works, Long Island City, N. Y., has developed the "Irving Unified" system of reinforcement and floor armor, which is especially suited to bridges. Two advantages claimed are saving in floor weight and reduction in floor maintenance costs. It is claimed that a slab of Irving Unified, 5 inches deep ($4\frac{1}{2}$ inches top to bottom of steel, with $\frac{3}{4}$ inch bottom covering) is equivalent to a 7-inch slab of reinforced concrete, span to span. The 7-inch slab of concrete weighs 85 pounds per square foot, while the equivalent slab of Irving Unified weighed 65 pounds, thus saving 20 pounds of dead load per square foot. This dead load saving allows a reduction in truss steel, or an increased margin of load. Through these reductions, the extra cost of this type of



IRVING UNIFIED REINFORCEMENT

construction is overcome; while the elimination of bridge floor maintenance by floor armoring, is an additional and continuing economy. The replacement of existing bridge floors by the construction, it is stated, would permit these bridges to carry heavy modern loads, in many cases, without rebuilding, due to the saving in dead load.

ACKER CORE DRILLS

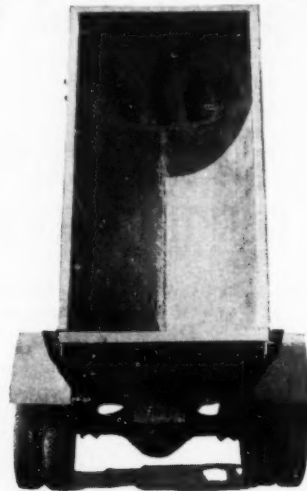
The Acker Drilling Co., Scranton, Pa., manufactures light-weight core drills which can be handled and moved by two men, and used in places where heavier machines would require costly frame-work or cribbing. In addition to obtaining samples of underground strata just as they lie, and exploring foundations, Acker drills are also used for testing pavements, and will cut 10 to 15 cores a day, using steel shot as the cutting media. Diamond bits may be used, if desired. Downward feed and pressure can be varied by a friction spring to suit the material. There are no hand levers or counter weights to regulate the pressure. The drill can be dismantled in a few minutes and folded up for transportation. The standard supporting the drill is hinged at the top and bottom, so that holes can be drilled at any angle.

WOOD "BATH-TUB" BODY FOR WET CONCRETE.

The Wood Hydraulic Hoist and Body Co., Detroit, Michigan, has brought out the "bath-tub" body, which is claimed to solve the problem of handling wet concrete. It is semicircular in cross-section and the sides are straight for a short distance above the concavity of the body. There is a rounded plate in the front end of the body, so the entire inside surface is smooth, with no square corners. The tailgate is fitted with a round iron bar, bent to conform to the inside curvature of the body. This iron bar is fastened on the front side of the tailgate. When the tailgate closes, the round iron bar forms a "V" in the bottom of the body, into which the wet concrete is forced by pressure, making an absolutely tight joint.

Practical demonstrations have proved that this semicircular bottom prevents wet mix from sticking, since an equal

pressure is exerted downward and in from the curved sides; and this and the curvature of the front end prevent the wet material from settling close to the steel and allows the body to clean itself

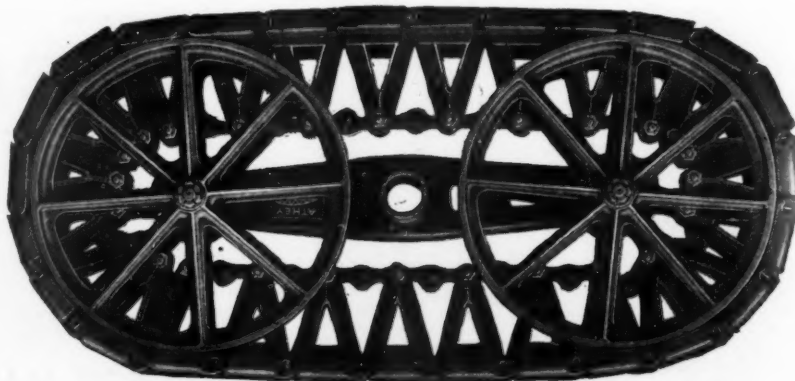


WOOD "BATH TUB" BODY FOR TRUCKS

quickly when the load is dumped. The body has extension sides, so that when a one-batch load is hauled the additional height of the sides prevents the wet mix from spilling while the truck is enroute to the place where it is to be dumped.

ATHEY TRUSS WHEEL WAGON

The Athey Truss Wheel Co., Chicago, Ill., manufactures the Athey Truss Wheel all-steel tractor wagon, which is especially adapted for use behind tractors, especially where the hauling of heavy loads over soft ground is a problem. Ninety per cent of the load is carried on the truss wheel, which is a tracklaying wheel of special construction, providing nine square feet of ground contact. The mechanical advantage of the Athey Truss Wheel is that it is equivalent to a wheel of great size, since it acts as an inclined plane which gradually raises the load over stones, ruts and other obstructions. The light running qualities are due to the combination of track wheel mounted on anti-friction bearings, rolling on a rigid steel track. It is claimed these wheels operate with 30 to 50 per cent less tractive power.

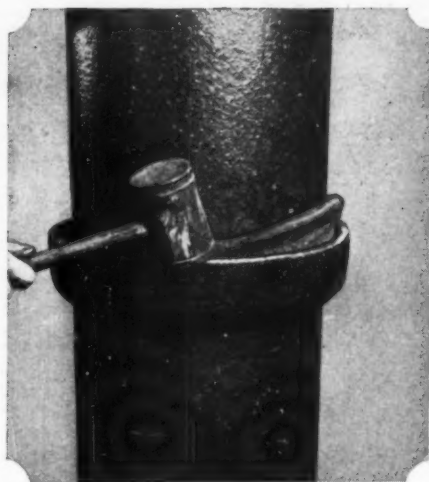


ATHEY TRUSS WHEEL

Servicise Your Sewers . . . Only One Material Needed and Only One Operation . . . Permanently Tight and Lasting . . . and at a Lower Cost per Joint!!!

Cold Process Installation— Expansion Belts

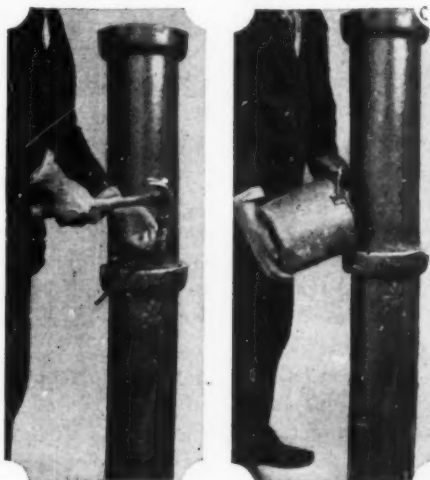
A reduction in the number of materials and operations lowers the cost per joint. Serviced Expansion Belts involve only one material and a single operation, and produce a lasting, water-tight joint. They are unaffected by sewer liquors, remain flexible, prevent root growth, and require no preliminary preparation for installation. The joints remain intact even though movement of the pipe takes place, thus providing permanently tight connections which do not disintegrate.



Ramming Expansion Belt into Place

Sewer Pipe Plastic Cement

Conditions for laying pipe are often poor and complete protection against leakage sometimes requires additional material. Serviced Plastic Cement is an adhesive bitumen of troweling consistency which is recommended for use with the expansion belt. It unites readily with the belt material and hardens to a tough flexible compound after application. Wet trenches, irregular pipe, careless installation, etc., are obstacles which plastic cement surmounts, and the danger of poor joints due to adverse conditions is minimized. It replaces cement grout in the troweled type of joint and the disadvantages of hard rigid jointing material are eliminated.



Caulking Pipe With Bitupack

Pouring Sewer Pipe Compound

Hot Process Installation— Poured Compound

Hot poured sewer pipe compound is often specified in preference to the expansion belt. The completed joint is equally as effective and capable of withstanding higher pressures.

Serviced Bitupack and Sewer Pipe Compound combine to form an ideal bituminous joint. Bitupack seals the base of the belt and holds the pipe in position during pouring. It caulks readily, is not subject to decay, and unites with the compound to form a homogeneous joint. The compound is tough, non-brittle, high melting point bitumen containing inert mineral filler. When heated to 400° F. it flows readily and no difficulty is experienced in obtaining a complete joint at a single pouring. The Bitupack-Compound combination is the latest development in poured joints and flexibility as well as tightness predominate among its many advantages.

Concrete Tanks and Reservoirs

Use Serviced Type D Expansion joint for all joint installations.

Use Serviced Rubber Oil as a seal between footings and floor slabs.

Use Serviced Waterproofing to make the concrete impervious to moisture.

SERVICISED PRODUCTS CORPORATION

Factory and General Offices:

6051 WEST 65th STREET, CHICAGO, ILL.

Sales Offices:

Monadnock Bldg., Chicago, Ill.

Bankers Trust Bldg., Philadelphia, Pa.

Dime Bank Bldg., Detroit, Mich.

DISTRIBUTORS AND DEALERS IN PRINCIPAL CITIES

Your inquiries addressed to any of these offices will be referred immediately to our representative in your district.

SERVICISED
PAT. OFF. © 1918
REG. U.S.

SEWER PIPE JOINTS

Floods Again!



WIDE WORLD PHOTO

THE RAGING CONNECTICUT RIVER—NOV. 1927—BELLOWS FALLS, VT.

—Are YOU Ready?

AGAIN a calamitous flood—this time in New England—an area notably free from flood conditions heretofore. Unprecedented rains, continuing hour after hour, swelled brooks to rivers, rivers to torrents sweeping everything before them.

Again the inescapable pollution of water supplies and the consequent dread of typhoid fever and pestilential disease.

Again the call for help—the emergency dispatch on a Sunday evening (seven hours after the call had been received) of a truck load of chlorinators and chlorine and an auto full of our engineers, on an errand of mercy—to combat the germs of disease. A wild, all night ride through driving snow—almost impassable detours because of washed out bridges and demolished roads. A week

of herculean effort installing chlorinators, sterilizing water supplies, disinfecting mains, making water safe to drink.

And again we ask——

“WHY WAIT FOR THE FLOOD?”

Any water supply anywhere is liable to such unforeseen pollution as came to New England—as it came to the Mississippi Valley—and as it has come hundreds of times to thousands of places heretofore. To protect against this unexpected pollution, every water supply should be chlorinated regardless of its source.

Chlorination costs but one cent per capita per year. It is the cheapest public health insurance—and the time to provide for chlorination is before the emergency comes.

“The only safe water is a sterilized water”



WALLACE & TIERNAN

COMPANY, INCORPORATED

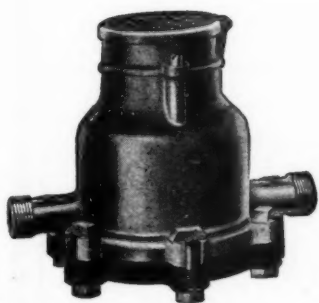
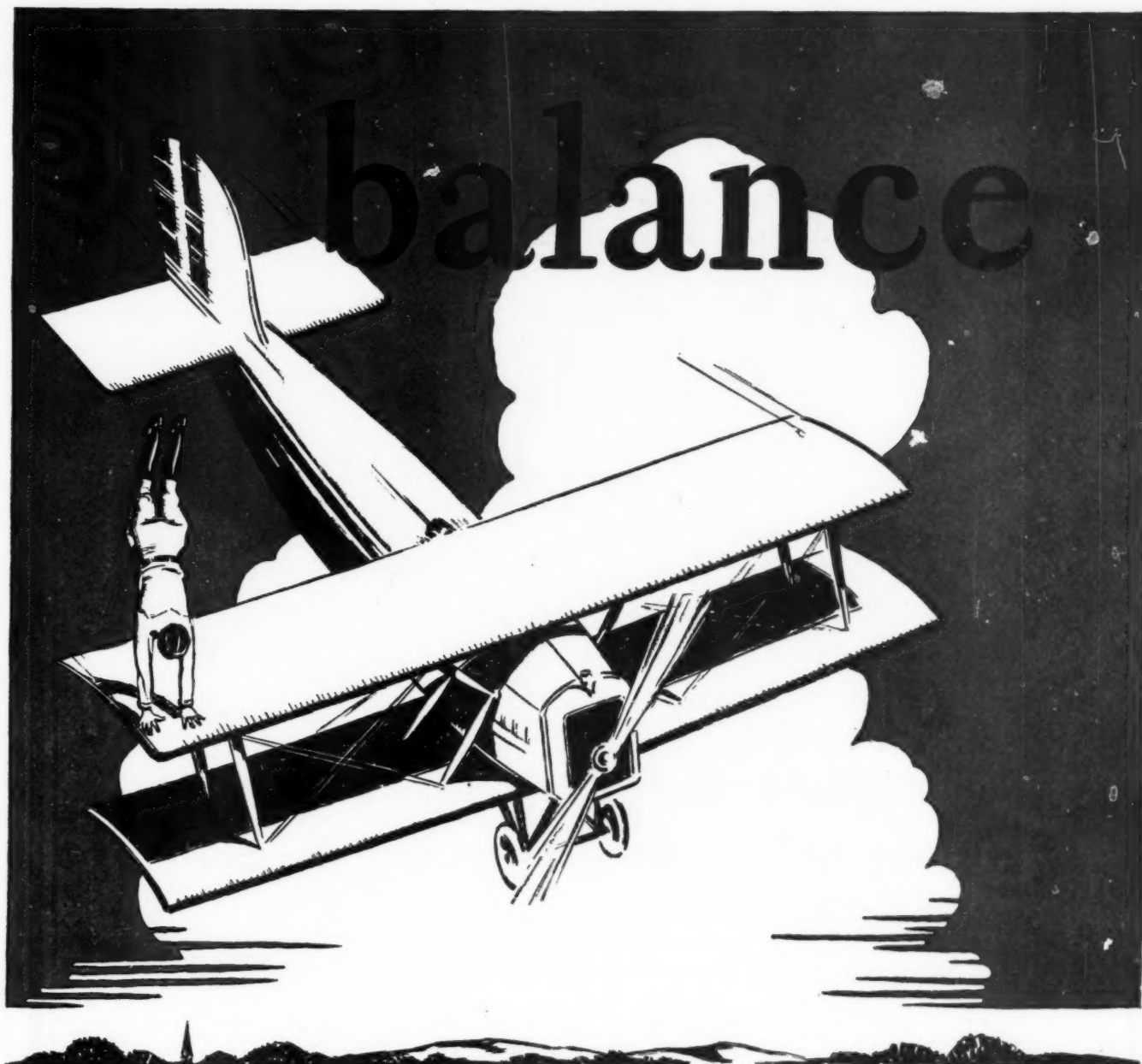
Manufacturers of Chlorine Control Apparatus

NEWARK

NEW JERSEY



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LOS ANGELES SEATTLE ST. LOUIS BUFFALO HARRISBURGH INDIANAPOLIS DETROIT
WALLACE & TIERNAN, LTD., TORONTO, CANADA WALLACE & TIERNAN, LTD., LONDON, ENGLAND



Why is each Hersey Water Meter dipped-tinned? Because this method (expensive as it is for us) is the only process which satisfactorily protects a meter against corrosion over a period of years.

THE Disc Piston of a Hersey Water Meter reacts accurately to the slightest impulse of a tiny stream. . . or the force of the highest rate of flow because it is perfectly balanced. Wear and internal friction—the two greatest enemies of long-continued registration accuracy—are thus held in check.

Hersey Manufacturing Company, South Boston, Mass.

HERSEY WATER METERS

NEW YORK, N. Y., 290 Broadway
PORTLAND, OREGON, 475 Hoyt St.

PHILADELPHIA, PA., 314 Commercial Trust Bldg.
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Main Office and Works: Corner E and 2nd Streets, South Boston, Mass.

Warrenite-Bitulithic Pavement

—“A WARRENTed Product”—

And again.....Economy.

Practically the last thing to consider when economy is concerned is initial cost. You can install cheaper roads than Warrenite Bitulithic Pavement—and incidently much more expensive ones, too,—but we repeat: initial cost is not economy.

Repairs and replacements regulate the true road costs.

Somewhere in your vicinity there is a road of Warrenite Bitulithic Pavement. Seek it out, examine it,—then ask us to tell you why that particular road is economical.

Warren Brothers Company

International Highway Engineers and Contractors

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Oklahoma City, Okla.



Ewing Galloway

The City of St. Louis *selects* Four Dorr Traction Clarifiers

IN the new Missouri River water treatment plant four 150 ft. Dorr Traction Clarifiers will be operated. Two of the machines will normally be used as presedimentation units; the other two will be used for sedimentation of the softened water leaving the mixing basins.

Strong and rugged, but trim in appearance, Dorr Traction Clarifiers can profitably be used wherever the need for a sedimentation unit arises—in either sewage or water

treatment work. The powerful traction drive propels the mechanism smoothly and surely. There is no heavy superstructure or large housing over the tank. All bearings are above the water level.

The choice of Dorr Traction Clarifiers for this important work at St. Louis, followed exhaustive tests which demonstrated that large savings could be effected by clarifier operation.



Send for Bulletin No. 6171

THE DORR COMPANY ENGINEERS

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THE DORR CO. LTD.
16 South Street, London EC 2

TORONTO 330 Bay St
DORR G.m.b.H.
Joachimsthalerstr 10 Berlin W 15

CHICAGO
310 S Michigan Ave
ATLANTA
1503 Candler Bldg
JOPLIN
319 Joplin National Bank Bldg
SOC. DORR et CIE.
126 Rue de Provence Paris 8

INVESTIGATION

TESTS

DESIGN

EQUIPMENT



Unknown quality is only a mirage of safety

THE desert is dotted with the bones of men, deceived by some mirage. Likewise the business trail is strewn with evidence of calamity caused by the mirage of unknown quality. The wisdom of protection through **known** quality has long been recognized by shrewd business men. That wisdom is likewise recognized by the Williamsport Wire Rope Company who have eliminated the mirage of unknown quality in

WILLIAMSPORT **WIRE** Telfax Tape Marked **ROPE** Factory Certified

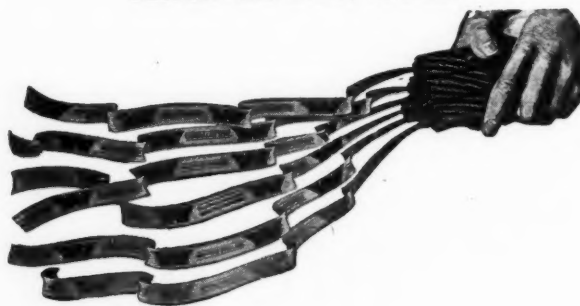
The grade of all Williamsport Wire Rope is marked in an unmistakable and permanent way by the Telfax Tape woven into and throughout the hemp core.

You must have the safety of workers at heart—if you want to know the grade of rope you use—if you have the vision to see the real economy of certified wire rope—you'll surely specify Williamsport Wire Rope, the rope of superior quality plus definite protection against substitution.

Williamsport Wire Rope Co.

Main Office and Works:
WILLIAMSPORT, PA.

General Sales Offices:
PEOPLES GAS BLDG., CHICAGO



WILLIAMSPORT

CERTIFIED WIRE ROPE

USE MADESCO TACKLE BLOCKS. THEY STAND THE GAFF

LOCK JOINT REINFORCEMENT

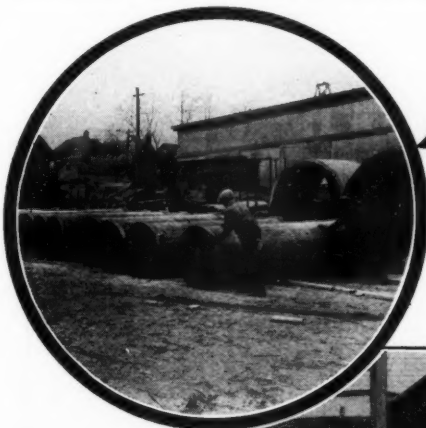


Assembling the Steel Cylinder

THE STEEL CYLINDER and the CAGE OF WELDED BARS are disposed in a way to obtain the best possible advantages from the TENSILE STRENGTH, the ELASTICITY, and the IMPERVIOUSNESS of the STEEL, combined with the COMPRESSIVE STRENGTH and the excellent PROTECTIVE QUALITIES of the CONCRETE.

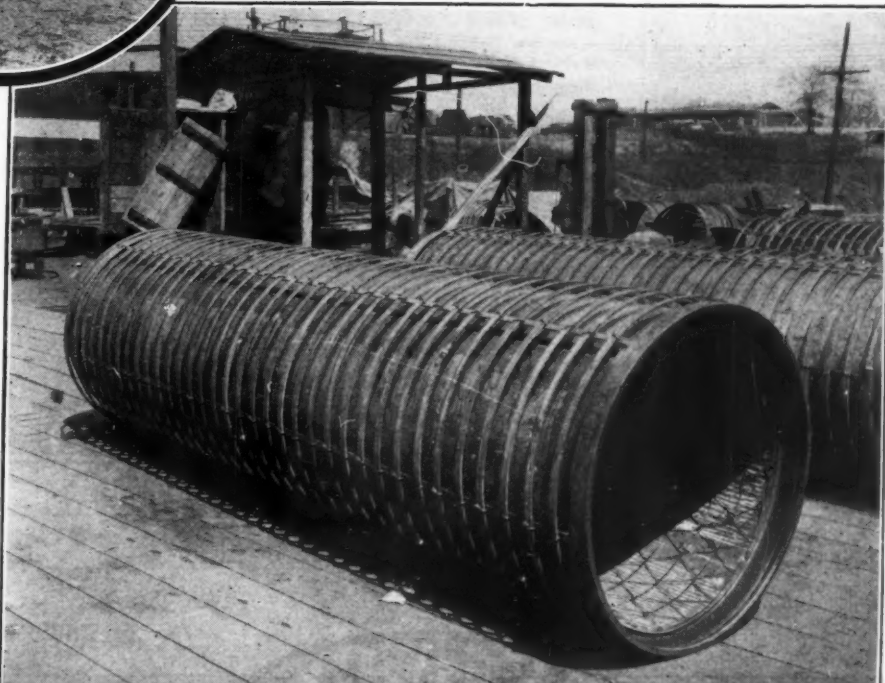


Welding the Steel Cylinder



Finished Steel Cylinders

THE LOCK JOINT PIPE COMPANY is at present building pipe lines of this type for the cities of BOSTON, PROVIDENCE, NEW YORK, WASHINGTON and BIRMINGHAM.



Steel Cylinders Assembled with Bar and Wire Mesh Reinforcement

LOCK JOINT Reinforced CONCRETE PIPE

Lock Joint Pipe Co.

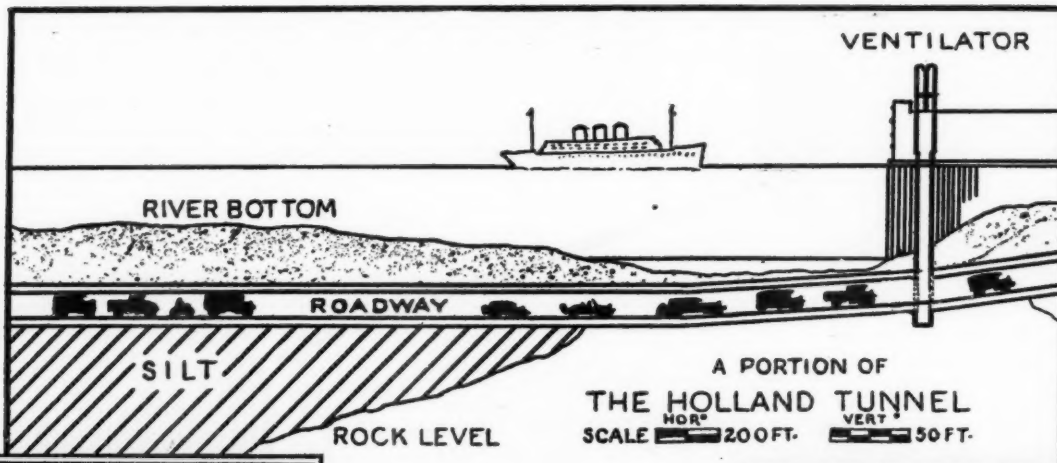


Pressure, Sewer, Culvert Pipe



Ampere, N. J.

Blasting in a Bubble..

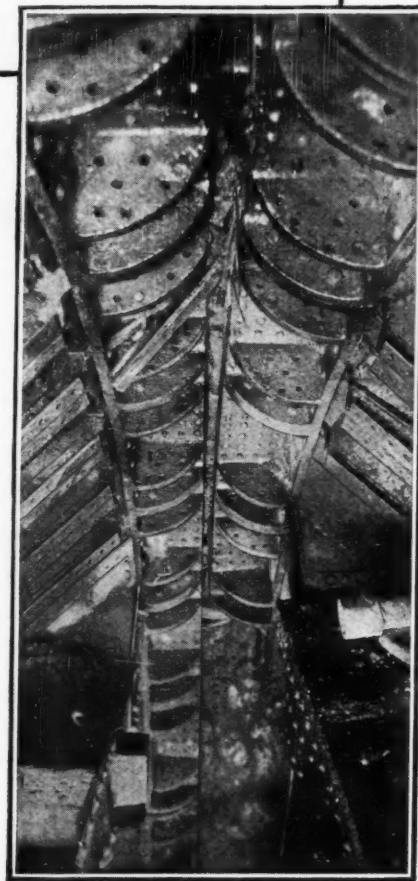


THE above profile indicates the rock which had to be blasted out to make way for the tunnel. 12,177 cubic yards of rock were blasted in the tunnel and 5,056 cubic yards in the shaft to the ventilating building on the New York side.

(Left) North Tunnel: New York and New Jersey shields the day prior to their junction. Booth & Flinn, Ltd., contractors.

(Right) Meeting of the upper cutting edges of the New York and New Jersey shields in the North Tunnel. They met under the Hudson River at about Sta. 64/50. Booth & Flinn, Ltd., contractors.

All work on the tunnel was under the direction of the New York and New Jersey Bridge and Tunnel Commission.



DU PONT

Reg. U. S. Pat. Off.

.....to build the.. HOLLAND TUNNEL

Between New York and New Jersey
Under the Hudson River

Men who gamble with life . . . locked in a huge bubble of compressed air . . . 107 feet below the city streets . . . beneath the bottom of the mighty Hudson . . . their lives held in the very balance . . . the balance between compressed air pressure and hydrostatic pressure of tons and tons of water . . . no escape . . . shut off from mankind and the world above by the great steel cutting shield . . . all about them a formless world of water, silt and rock . . . up to their knees in muck and slush . . . **SUDDENLY A DENSE FOG HIDES THEM FROM EACH OTHER** . . . the fearsome noise of rushing water . . . they wait still and tense . . . to be buried alive . . . or to carry on . . . the shield stops moving . . . the fog clears . . . rock struck . . . the tunnel must not deviate from its course a fraction of an inch . . . rock drillers enter the bubble . . . the obstruction is loaded with dynamite . . . men



[[George H. Flinn, Chairman of Booth & Flinn, Ltd., firing final blast for holing through North Tunnel.]]

retreat back of the shield . . . a dull "boom" and the giant jacks push the shield ahead.

Daily in those four long years every man from the chief engineer down to the lowest sand-hog grinned at Death. There was no other way to build the greatest twin vehicular tubes in the world. 9,250 feet long, a two-mile sub-aqueous street thirteen feet six inches high and twenty feet wide.

Twelve thousand, one hundred and seventy-seven cubic-yards of rock were blasted in the tunnel under these conditions and five thousand and fifty-six cubic yards of rock blasted in the New York ventilation shaft down to the tunnel. 73,950 pounds of 60% du Pont Special Gelatin and 69,200 du Pont Electric Blasting Caps were used in blasting these 17,233 cubic yards of rock. Despite the extremely dangerous conditions under which this blasting was done, not a man was injured. The explosives were delivered every morning and the unused explosives removed at night by du Pont delivery boats.

Where life and the success of so great an undertaking were at stake, naturally the engineers in charge of this work selected du Pont explosives and accessories. There is a vital significance in the association of du Pont explosives with great construction and industrial enterprises of the Nation.

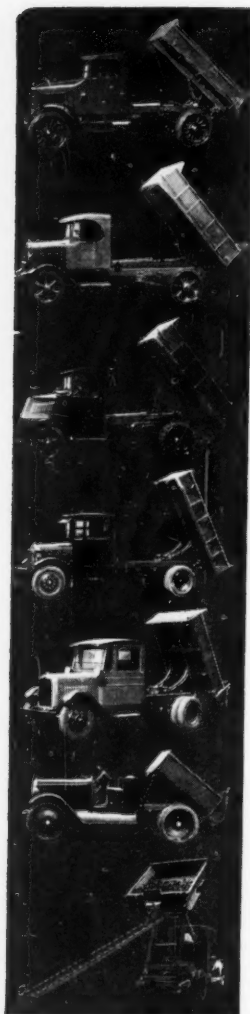
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Explosives Department
WILMINGTON - DELAWARE



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Wood Dumping equipment is the Answer. Wood builds hoists and bodies for every purpose.

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3 Types
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Self Dumping Hoists
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12 standard designs
Special bodies built to
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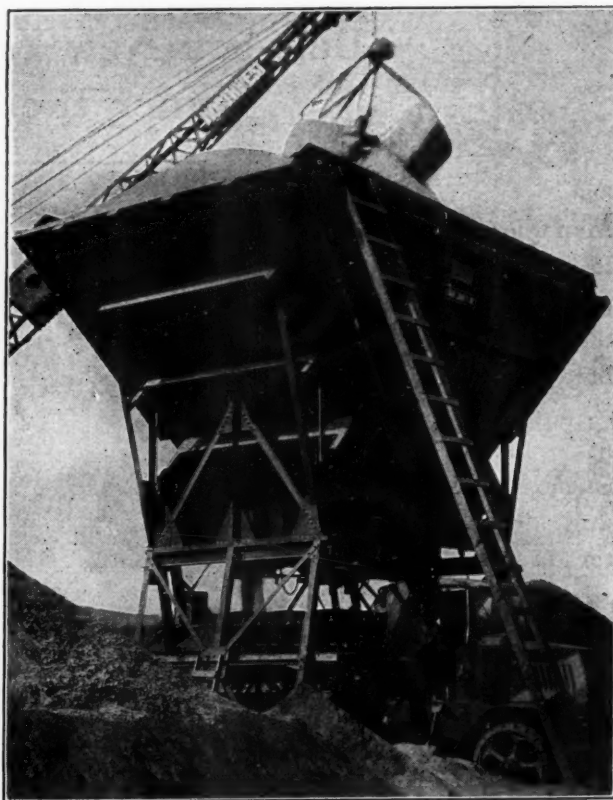
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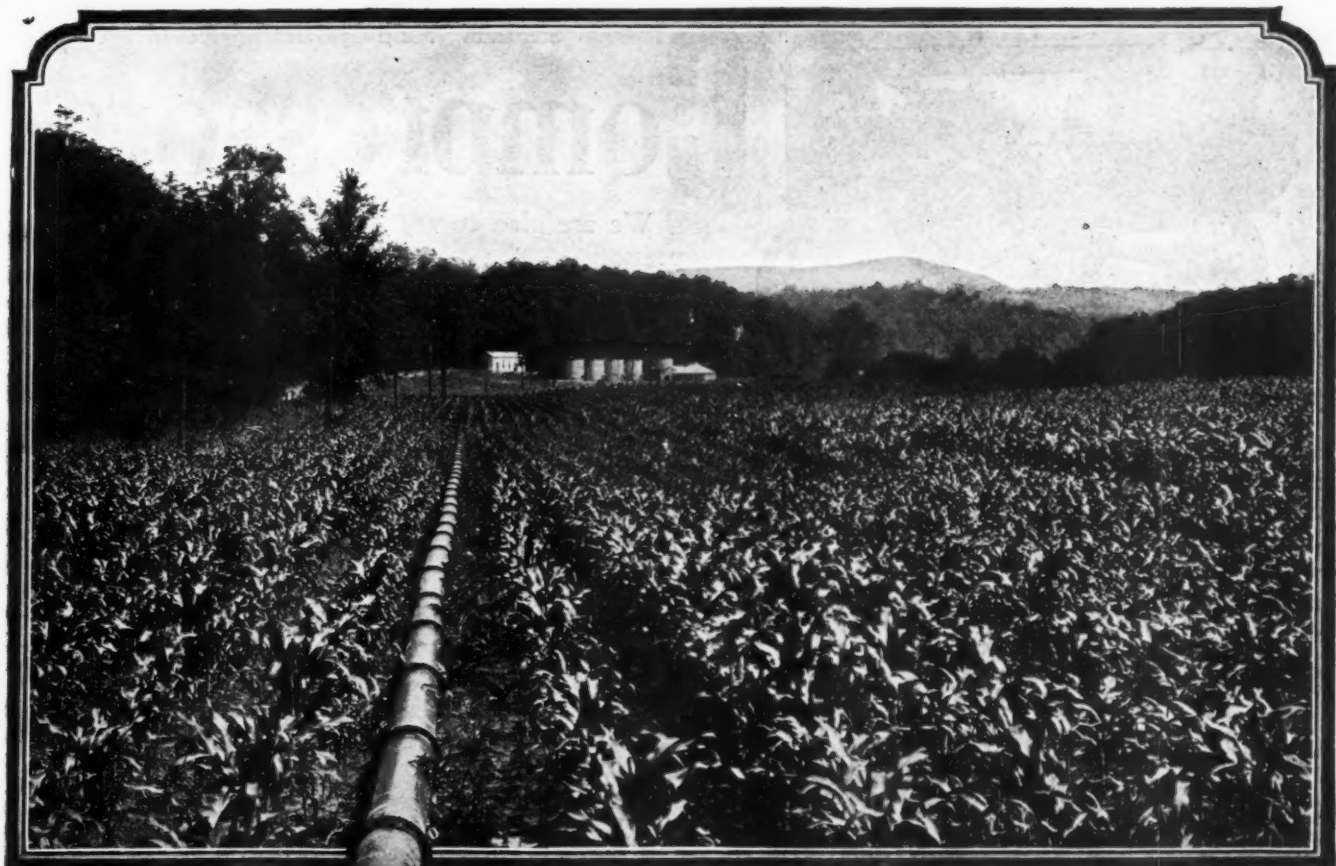
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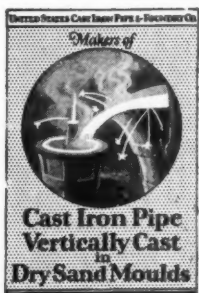
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THE high tensile strength of deLavaud centrifugally cast Cast Iron Pipe makes it ideal for pressure lines.

Due to the density of the iron cast—by the deLavaud centrifugal method—there is no seepage.

The line illustrated here was tested at 260 lbs. pressure and is subjected daily to a pressure of 230 lbs. per sq. in.

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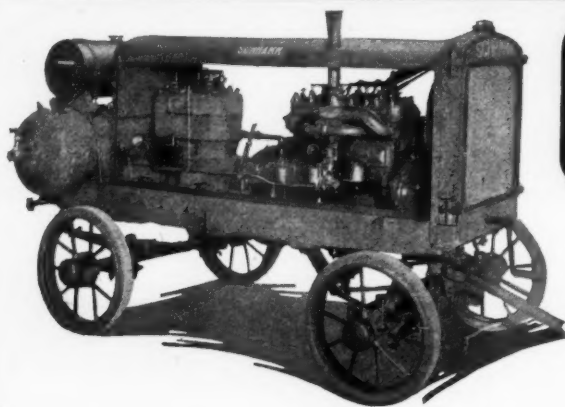
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Some of the outstanding features:—Powerful "Buda" Engines coupled to large capacity Schramm Compressors. (Also made with electric motor drive.) Capacities from 60 to 240 cu. ft. Automatic governor to prevent racing of unit with no load. Gasoline strainers to keep grit and dust out of the carburetor. Heavy duty clutch permits easy starting—cut in the compressor after the engine is "warmed up." Adapted to truck, trailer or skid mounting or for use with a tractor.

A card brings the Schramm Catalog. We are glad to advise you on any compressor problem. Write.



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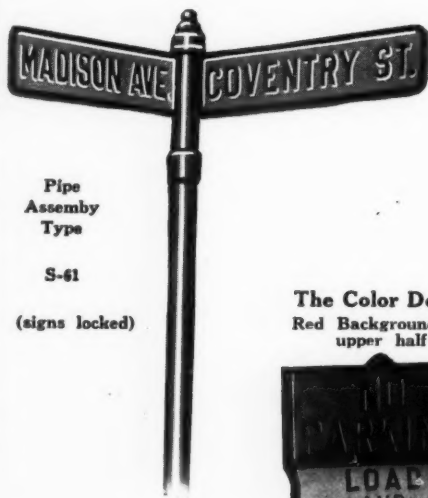
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5. Simplicity.
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Pipe
Assembly
Type

S-61

(signs locked)

The Color Denotes the Regulation before Shield Can Be Read.

Red Background on
upper half



S-520

White Background



S-521

Yellow Background



S-522



S-1025
Unit
Head.
Electric
Beacon.
(Flashing)

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for SHOVEL · DITCHER · CRANE
SKIMMER AND DRAGLINE WORK



Sherrill-Blackwell Construction Company

Bedford, Indiana

August 22, 1927.

Insley Manufacturing Co.,
Indianapolis, Ind.

Gentlemen:

This will acknowledge your letter of the 18th inst., inquiring as to the results obtained with our Insley Excavator No. 630, and we are pleased to advise that we purchased this machine from you at the beginning of the season with skimmer attachment. We have found this machine to be *entirely satisfactory* and economical in the class of work we are doing, namely, taking the old macadam off of streets, which is very hard digging. Later we purchased a ditching attachment for this machine and put in a sewer ranging from three to eleven feet deep and we had equally as good results with this attachment as we did with the skimmer.

You may feel perfectly free to refer anyone to us for recommendation, as we are thoroughly convinced the *Insley Excavator is the most efficient machine of its kind on the market.*

Yours very truly,
SHERRILL-BLACKWELL CONSTR. CO.
By W. H. Sherrill.

WHS:HCF

What More Could Be Said?

HERE is another Insley owner who believes that "the Insley Excavator is the most efficient machine of its kind on the market."

When you rip up old macadam streets or dig ten or eleven foot sewer trenches through clay, gumbo and hard pan, with an occasional limestone ledge, you are doing work which only the best will handle satisfactorily. This is what the Sherrill-Blackwell Construction Company are doing with their Insley.

When you own an Insley and put it through its paces, on one job after another, and when it does them all well and economically, you too will say, "entirely satisfactory." What more can anyone say?

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and
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with
**Headley
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An Asphaltum Emulsion

For Repairs and Resurfacing

HEADLEY No. 1 is adapted to present needs for the following reasons:

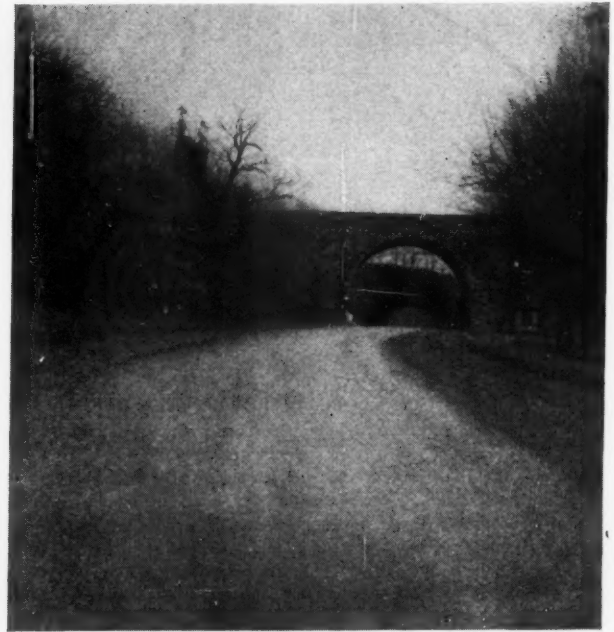
- It is lower in cost.
- It lasts longer.
- Maintenance less and easier.
- Surface smoother and waterproof.
- Not affected by changes in temperature.
- No expensive heating plant required.

Write for Descriptive Booklets

ASPHALT AND ROAD OIL

Headley Good Roads Co.

Franklin Trust Building Philadelphia, Pa.



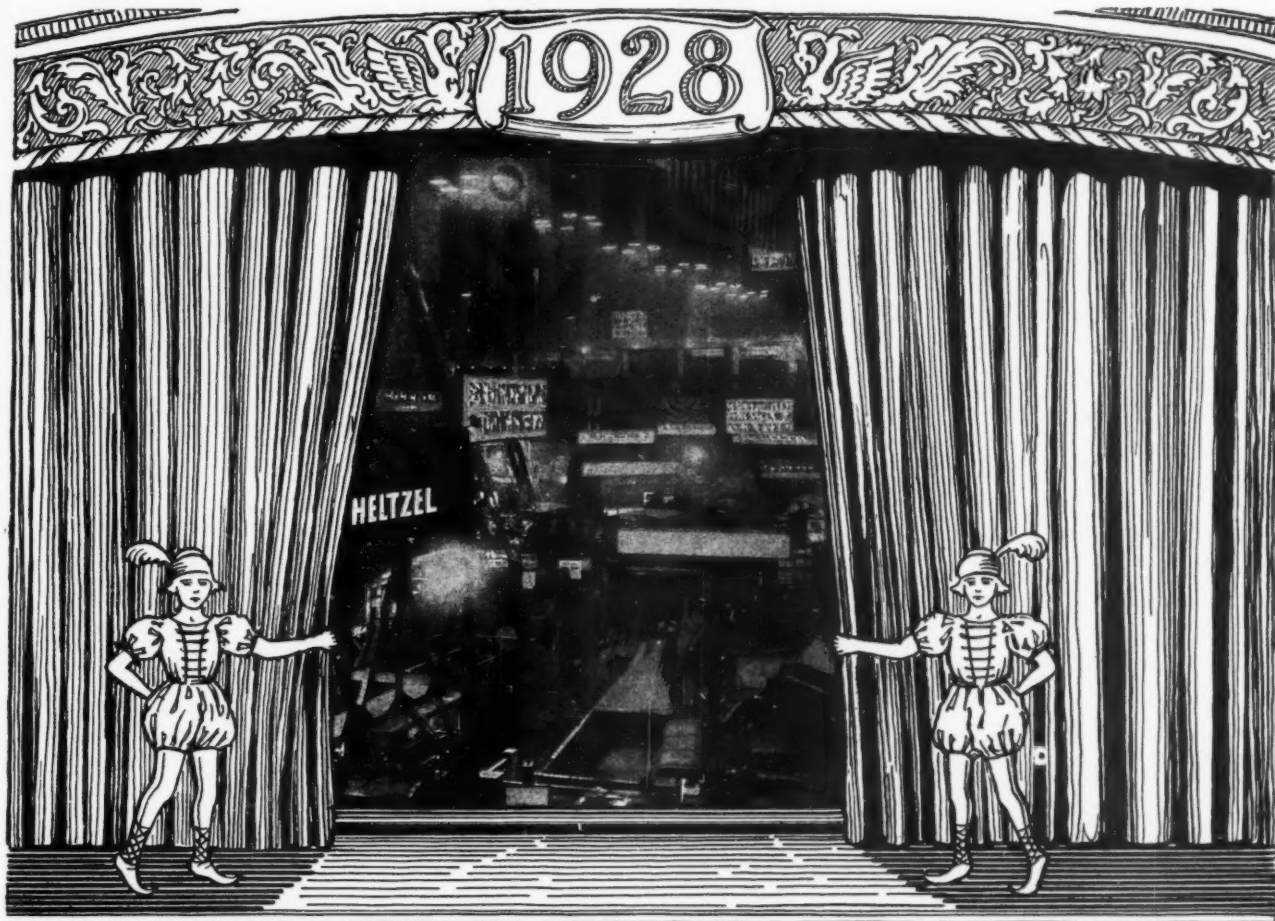
Our more than thirty years' experience enables us to select materials and design equipment which will render the best service. The number of Buffalo-Springfield Rollers now in use is not equalled by that of any other make of roller produced in America or abroad.

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The Buffalo-Springfield Roller Co.

Springfield, Ohio

BUFFALO-SPRINGFIELD ROLLERS



What Is This Secrecy Surrounding Heltzels 1928 Road Show Display?

WHAT are these rumors going 'round that HELTZEL has developed a new steel road form which is years ahead of the times? A wee small voice says wait, examine and see it with your own eyes.

What is this new mechanical joint machine for installing longitudinal and transverse joints in city streets and roads and this new collapsible form for the same purpose?

What are these new yoke type curb forms?

And material handling equipment! Absolutely no details until the road show. But, listen! So much contractors' equipment is

going out of date in 1928 that every contractor and engineer will wonder what is coming next.

If you can't be at the show, write HELTZEL and put your name on record for any of these new HELTZEL catalogues:

Modern Road Building Equipment.

Modern Street Building Equipment.

Modern Material Handling Equipment.

No copies released until after January 10th, 1928.

See HELTZEL display at Booth AA4, Auditorium, Cleveland, Ohio, Road Show, January 9th to 13th, 1928.

THE HELTZEL STEEL FORM & IRON CO., WARREN, OHIO.

HELTZEL

RUSSELL Records Grow

10 states that
lead in the use of
**RUSSELL
MOTOR PATROLS**

California	40
Delaware	24
Florida	16
Illinois	51
Iowa	86
New Jersey	69
Ohio	110
Texas	24
Washington	56
Wisconsin	96

East and West--Jersey (69) and California (40)
North and South--Wisconsin (96) and Texas (24)
Central States--Ohio (110) and Illinois (51)

Where Road Maintenance is Most Active there RUSSELL Motor Patrols are Paramount

Actual purchases by others is convincing evidence and you may well consider this in your own maintenance work—that is all we presume to suggest.

From every angle Russell Motor Patrols are proving to be the ideal maintenance equipment—sturdy and efficient with weight where it counts—speed and adaptability to actual road conditions.

With these highly finished machines comes refinement of design eliminating mere clumsy weight—machines which give speed and ease in control and a standard of efficiency which can scarcely be overestimated—then too, they afford a minimum of up-keep cost.

Here are specifically some of the dominating features—cut gears completely enclosed, Timken bearings, bronze bushings and collars for worm shafts, ball and socket connections in lifting links, tight joints, large circle for blade and long wheel base.

The complete Russell Line for Road Construction and Road Maintenance includes—

- 4 Sizes Motorized (Unified) Road Machines
- 10 Sizes Road Machines (for Horse or Tractor Power)
- 3 Sizes Elevating Graders

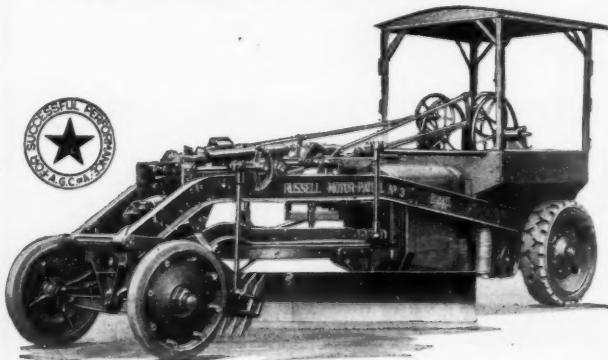
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THE W

Spots The Dipper Far Out~



And Holds The Load

The TIP-AND-TILT Dipper Gives Five NEW Back-Digger Advantages!

IN removing one limitation of the ordinary Back-Digger Thew gained no less than five new and distinct operating advantages over any existing type of Back-Digger equipment. Not only is it now possible to undertake trench and certain classes of ditch and cellar excavation with the assurance of better work at a very low cost, but there are new operations which take the Back-Digger out of its former restricted field and make it a many-job, all-the-year-'round machine.

The outstanding difference of the New Thew Back-Digger is the operator-controlled Tip-and-Tilt Dipper. Now the load can be held until the dipper is spotted at any point—close in or far out—over truck, wagon, bin or spoil pile—then instantly dumped. This one feature opens up new jobs and new profits.

In all the world there is no other machine that can successfully undertake these five operations—

1. Hold material in the bucket until it has been brought to any desired dumping position.
2. Completely empty the dipper into trucks, wagons or bins without spilling or dump exactly where the operator wants it on a spoil pile.
3. Cut a vertical wall downwardly opposite the machine.
4. Control the cutting angle of the dipper for greatest efficiency in various materials or shapes of cut.
5. Back-fill without disturbing ground on which spoil bank has been dumped; overturning and completely emptying the dipper into the trench.

Thew has again proved Engineering Leadership in the New Thew Back-Digger with the operator controlled Tip-and-Tilt Dipper. This Back-Digger equipment can be quickly and easily attached to any Lorain 60 or 75 machine in the field.

{ Full details of this New Thew Back-Digger are contained in Bulletin 409.
New excavating methods may affect your business—write today for your copy. }

THE THEW SHOVEL COMPANY, LORAIN, OHIO

THEW

SHOVELS—DRAGLINES

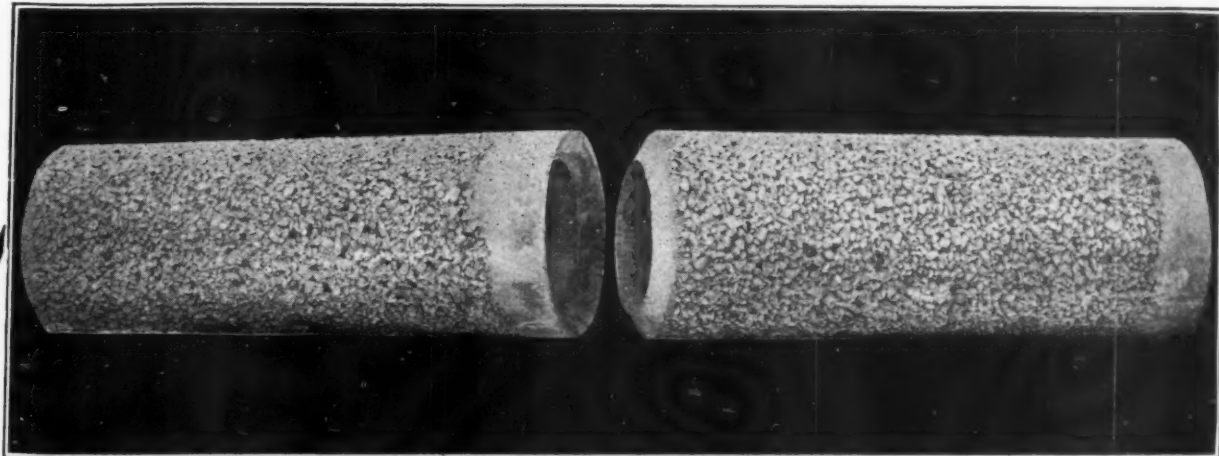
Gasoline Steam



CRANES—BACK-DIGGERS

Electric Powered

A NEW TYPE OF DRAINAGE PIPE



The most efficient and economical means of removing ground water along Highways, Streets, Reservoirs, Bridges, Sewage Disposal Plants, Mosquito infested swamps, Golf Courses, Athletic Fields, Public Parks, Airports, etc.

RAPID DRAIN PIPE

ENTIRE SURFACE ABSORBS WATER

NO OPEN JOINTS TO BECOME CLOGGED

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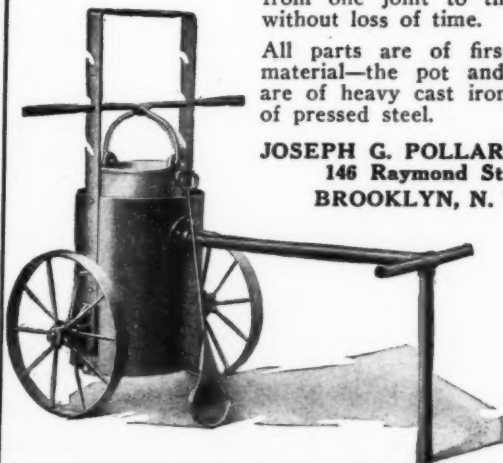
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Considerable time is saved on every pipe-line job by the use of a Pollard Lead Melting Furnace.

The Wheel Type Furnace can work along with the best of pipe layers. A ready supply of hot lead is quickly moved from one joint to the next without loss of time.

All parts are of first class material—the pot and grate are of heavy cast iron, ladle of pressed steel.

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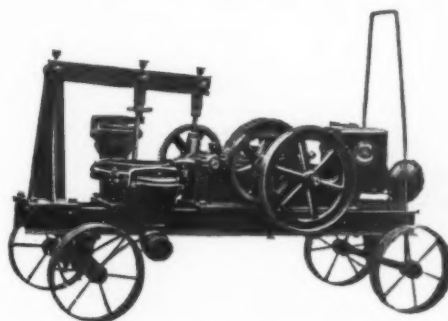


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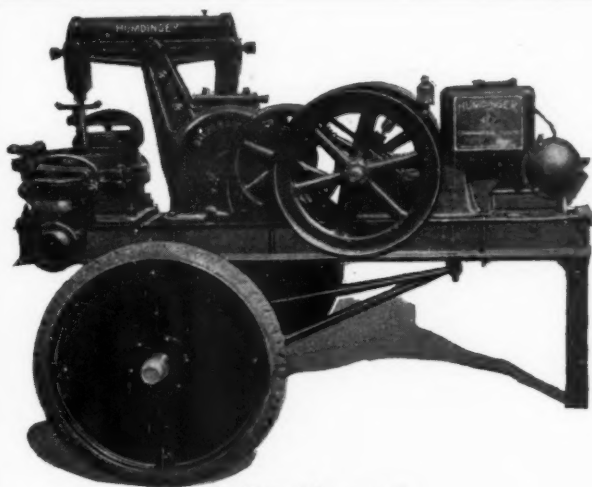
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The measuring disc used in these meters is thicker and more substantial than that used in any other make. It is reinforced with an aluminum alloy plate molded into the hard rubber making the disc practically unbreakable. All submerged bearings are protected against sand or sediment contained in the water. The intermediate gears revolve on patented enclosed pivot bearings, a feature found only in our meters.

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Hard jobs demand this heavy duty tape

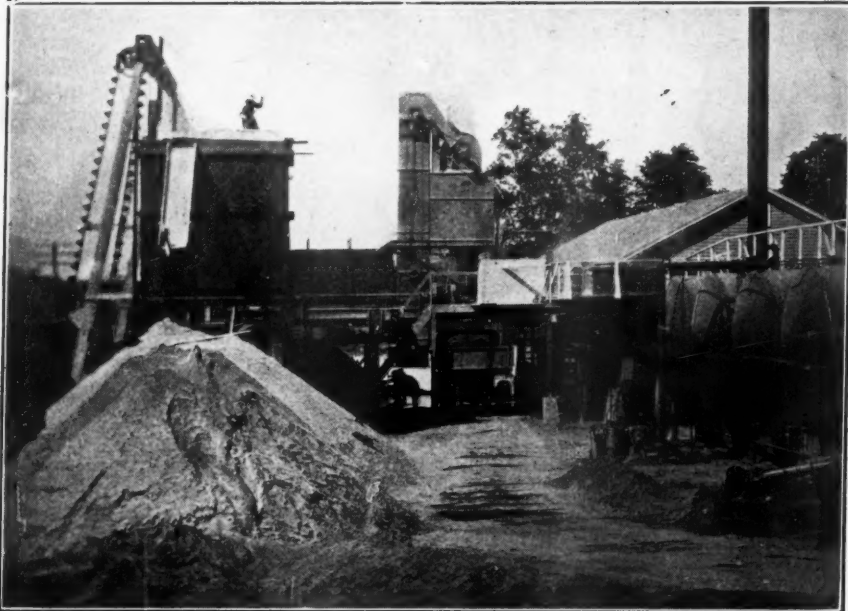
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Two units

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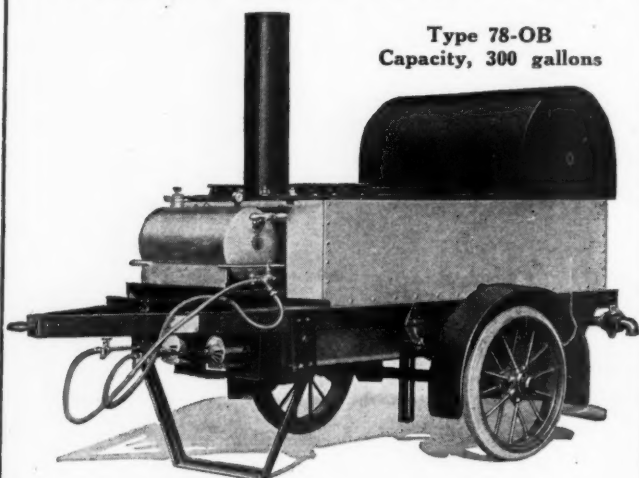
And come with full expectations of a special treat from the makers of CLETRAC CRAWLER TRACTORS. Again we say, you'll not be disappointed. Cleveland is the home of CLETRAC. We promise you a royal welcome. Full details at the CLETRAC Booth at the Road Show—and in the Road Show issue of this publication.

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Capacity, 300 gallons

Oil Burning—fast heating!

Here's a heater developed to the highest degree of quality, a real high speed outfit capable of producing hot asphalt with maximum rapidity for maintenance work. The Littleford Oil Burning Trail-O-Heater is equipped with specially designed Littleford Burners, which are very simple to operate and are trouble proof. A feature of this heater is the high quality running gear which, with its shock absorbing springs and rubber tired wheels, make fast trailing safe. One section of cover consists of warming hood under which barrels can be drained. Draw off valves are located on each side of heater. Write today for full details and a quotation.

**Repair your Streets right through
the Winter Months!**

You can do it with Littleford Oil Burning Melting Kettles and Littleford Portable Oil Burners. They make street repairs possible right through cold weather and eliminate costly Spring repairs. We manufacture all types and capacities.

Write today for information on
Winter Street Repairing.

LITTLEFORD BROS.

452 East Pearl Street
CINCINNATI OHIO



**CURE CONCRETE
while you MIX IT!**

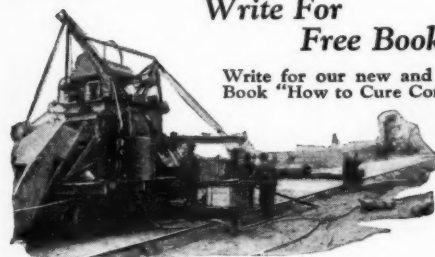


Many road builders who previously used Dowflake as a surface curing agent are now using it added directly to the mix in the form of a solution.

This admixture method results not only in greater economy and ease of handling, but also insures more uniform curing because the curing agent penetrates throughout the mix.

**Write For
Free Book!**

Write for our new and revised
Book "How to Cure Concrete".



THE DOW CHEMICAL CO., MIDLAND, MICHIGAN
Branch Sales Offices: 90 West Street, New York City
Second and Madison Sts., Saint Louis

The Belvedere Hotel

48th Street—West of Broadway
Times Square's Finest Hotel

Within convenient walking distance
to important business centres and
Theatres. Ideal Transit Facilities.

450 ROOMS and 450 BATHS

Every room an Outside Room with two large windows

Large Single Rooms, Size 11' 6" x 20".....	\$4.00 per day
For two, \$5.00	With Twin Beds, \$6.00
Large Double Rooms, Twin Beds, Bath.....	\$6.00 per day

SPECIAL WEEKLY RATES

Furnished or Unfurnished	Suites with serving pantry \$95 to \$150 per month
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Moderately
Priced

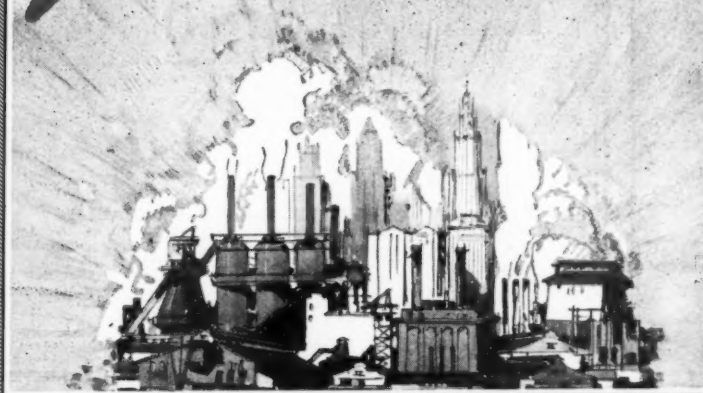
RESTAURANT

Peerless
Cuisine

Illustrated booklet free upon request

CURTIS A HALE, Managing Director

Mack



QUALITY

Fully Justifies

a Higher First Cost

REGARDLESS of commercial expansion or retrenchment—regardless of international relations—regardless of the development of new fields—in fact, regardless of economic forces, whether transportation demands be small or large, an ever-increasing percentage of buyers are learning from comparative operating costs records that there is an almost startling economy represented in the higher first cost of a MACK.

MACK TRUCKS, Inc.

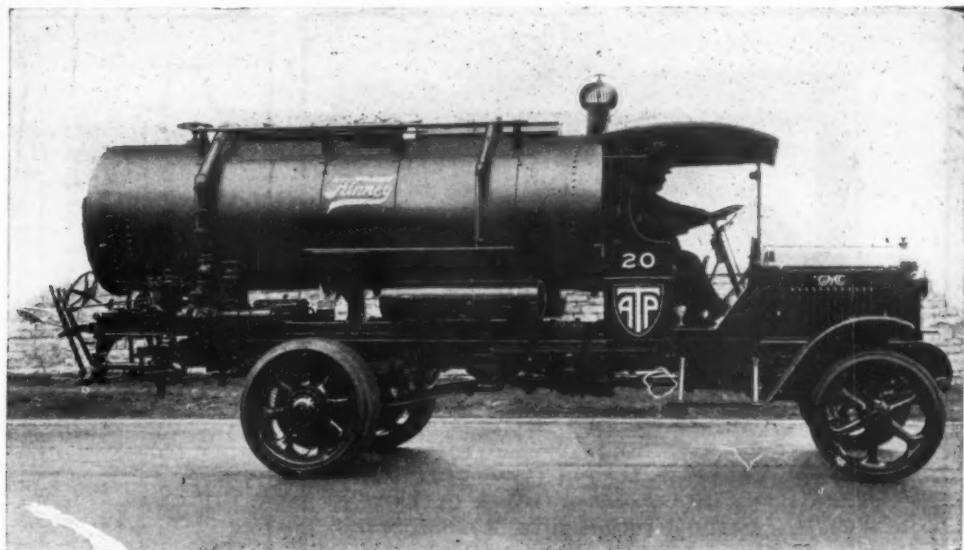
25 Broadway

New York City

More than one hundred direct MACK factory branches operate under the titles of: "MACK-INTERNATIONAL MOTOR TRUCK CORPORATION," "MACK MOTOR TRUCK COMPANY," or "MACK TRUCKS OF CANADA, LTD."

TRADE MARK
Kinney
REG. U.S. PAT. OFF.

**Time
Labor
and
Money
Saver**



The Kinney Heater and Distributor

Meets all specification requirements. Guaranteed to sufficiently heat and properly apply all varieties and grades of bituminous material for road construction and maintenance.

Kinney Manufacturing Company

BOSTON, MASS.

New York

Philadelphia
Philippine Islands

Chicago
Porto Rico

Houston
Cuba

Kansas City
Hawaiian Islands

San Francisco

TAR HEATERS

PORTABLE or STATIONARY

For Every Job



Style E
50 to 200 Gallon
A quick Heater. Kettle welded leak-proof. Enclosed Ash-pit prevents hot ashes or coals from falling underneath. Heater also mounted on roller bearing rubber tired wheels.

Oil Burners
Furnished
When Desired.

Other Styles
Shown in Catalog.

WRITE FOR PRICES ON

Tar Heaters
Sand Dryers
Fire Wagons

Transfer Wagons
Pouring Cans
Dippers

Mortar Boxes
Sewer Buckets
Salamanders

THE JOS. HONHORST CO.

1016-18-20 West 6th Street Cincinnati, Ohio

TRAFFIC SIGNS



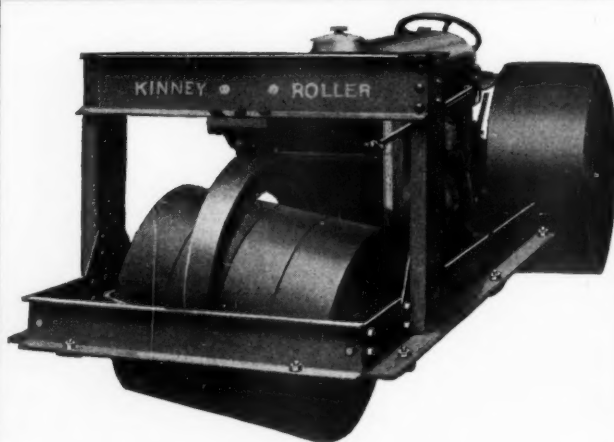
MOST EFFECTIVE—MOST SERVICEABLE

The above group shows various lettering that can be put on the signs. The signs should be painted Yellow with Black Lettering and Black Borders to get best results. All of our signs are furnished with a screw connection so they may be removed from standard and taken in to be repainted, and another sign placed in its position if desired.

Write for full particulars.



DUNCAN MACKENZIE'S SONS COMPANY
Trenton New Jersey.



The Kinney Roller travels fast or slowly as needed. Strong, thoroughly flexible, practically impossible to upset. Rides and works Rough or Smooth surfaces.

No better Roller on roads, foundations, sub-grades, embankments, fields and fairways, for owners, municipalities and contractors. 2, 3, 4, 5, 6 ton Kinney Road Rollers, Kinney Field Rollers and Kinney Lawn Rollers, use Fordson power. Interchangeable parts. Highest grade Attachments.

Steering, easy as driving a car. Rear tractor hitch and Front bumper couplers.

The Quality Roller—for You

KINNEY STANDARDS, Inc.

193 Clifton Place

Brooklyn, N. Y.



ROUND
HOLE
PUNCHING

CONCAVE
LUG
PUNCHING

RIVET LUG
(SPECIAL)

SWEET'S HERCULEAN STEEL POSTS

Rolled from the highest grade high carbon steel,—these posts—possess most remarkable strength and durability.

Write for Sweet's booklet describing the line of Herculean Steel Posts.

**Sweet's
Steel Company**

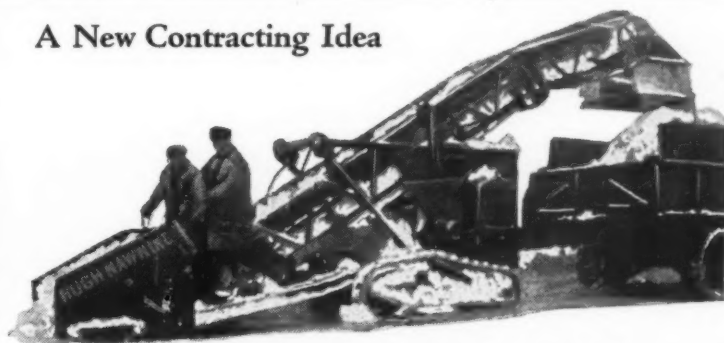
Manufacturers

Williamsport

Penna.

Tearing into snow storm costs at a rate that keeps your street and alley appropriation prosperous

A New Contracting Idea



Hugh Nawn, Inc., loads snow for the City of Boston. A Barber-Greene Snow Loader speeds up work, and keeps down costs.

A TIRELESS Barber-Greene Snow Loader can more than equal the strongest efforts of one hundred husky shovelers.

And the snow-hungry B-G needs no time out for rest, meals, bad weather or sleep. One B-G in Boston cleared streets for 112 hours—six days—without so much as a stop to “stretch its back.”

B-G's open traffic days sooner. With them, actually thousands and thousands of dollars—that are shoveled away in snow—can be saved, and spent for paving or repairs.

One Barber-Greene Snow Loader cut snow costs 56% for the City of Boston. It actually paid for itself in 14 days. One of its B-G's saves more than

\$10,000 of the City of Boston's street and alley appropriation every year.

The Boston Elevated Railway states that Barber-Greene's cost them 57c per cubic yard of snow removed. Their 4 B-G's saved over \$47,000 in one season—paying for themselves twice over. 10 Barber-Greene's keep their snow costs even lower now.

We would like to tell you how a great many other cities are saving their street and alley appropriation for better things than snow storms. “Modern Snow Removal” contains accurate and actual cost records of Barber-Greene's in action. Send for it today.

One B-G can fill all of these trucks in less than that many minutes—and keep doing so, as long as the snow lasts



1928 CONVENTION AND ROAD SHOW

AMERICAN ROAD BUILDERS ASSN.

JANUARY 9TH-13TH INCLUSIVE

CLEVELAND, O.

BARBER-GREENE COMPANY, 635 W. PARK AVE., AURORA, ILLINOIS



Snow Loaders

Representatives in 50 Cities

DISC FEED LOADERS

VERTICAL BOOM DITCHERS

STANDARDIZED PORTABLE AND PERMANENT BELT CONVEYORS

SNOW LOADERS

CAR UNLOADERS

COAL LOADERS

Comes Now: Winter Snow and Street Cleaning Problems



In Detroit this Universal Crane worked all one night and loaded 327 trucks in 12 hours. Smaller cities, too, can use Universal Cranes for snow removal in the winter and for pipe laying, excavating, lifting and unloading in other seasons.

Main arteries through New York City must be cleared after every snowfall with the least possible congestion and waste effort. With 1060 miles of street costs of the least inefficiency are prohibitive.

Consequently, in New York's formula:—

Snow plows

Universal Motor Truck Cranes

equipped with one yard or 1½ yard snow bucket, and

Heavy dump trucks

are assembled in commercial areas and congested intersections.

Plows bank the snow, Universal Cranes follow behind scooping up the piled snow, and trucks haul it away. This system is over 50% more efficient than hand shovel methods. Each crane eliminates the wages of 75 men.

Universals can follow close behind the snow plow and load 5 ton trucks at the rate of 3 every 10 minutes. **Greater ability to move down the streets at a minimum travelling time accounts for the fast performance.**

Actual costs of removing snow from city streets are presented in the "Snow Bulletin." Write for it!

THE UNIVERSAL CRANE CO.

914 Swetland Bldg.

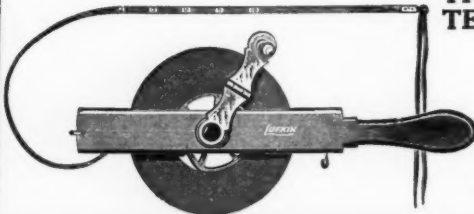
Cleveland, Ohio

LUFKIN

ENGINEERS and CONTRACTORS TAPES

Give Long and Satisfactory Service Even Under Severe Conditions of Use

FROM SURVEYS TO FINISHED CONSTRUCTION AND INSPECTION WE HAVE PATTERNS BEST SUITED TO EVERY PURPOSE



Stocked by Hardware and Engineering Supply Houses.

Send for Catalogue.

Ask About Our Genuine Stainless Steel Tapes
THE LUFKIN RULE CO. SAGINAW, MICH.
New York, London, Eng., Windsor, Can.



Smoothness—Economy—Power GALION



Four Cylinder

TANDEM MOTOR ROLLERS

in 5, 6, 7, 8, 9 and 10 Ton Sizes

Smooth easy operation—start at a moment's notice. No smoke or ashes. Perfect work on asphalt.

Galion Motor Tandems meet every need. The Galion line also includes Steam Tandems in the same weights.

Write for Complete Information

The Galion Iron Works & Mfg. Company, Galion, Ohio
Makers of All Types and Sizes of Rollers and Graders



OVER 200 ~ New England Communities USE Trackson-Fordsons for Snow Removal!

LAST YEAR, in New England alone, over 200 communities bought Trackson-Fordsons for snow removal, and hundreds of other cities and towns throughout the snow belt have found them an excellent investment for keeping roads open.

The experience of users in Northern Wisconsin, New York, New England, Canada, and throughout the snow belt, has proven that a fleet of Trackson-Fordson snow plow units, costing no more than a larger, heavier and more expensive tractor, will keep more miles of streets and roads open than any other method. Under the most severe conditions with heavy snow falls and deep drifts, and during the worst storms, they have found that these Trackson-Fordson plows will clear the snow quicker and keep the roads open at a lower cost than any other unit.

In addition to snow removal work, they can be very easily adapted to road building and maintenance, or any other work requiring sure-footed power with speed!—You can keep them working the year around!

Let us send you free, our special bulletin on low cost snow removal. It's yours for the asking—send for it today!

Trackson Company
MAKERS OF FULL-CRAWLERS
303 CLINTON ST. MILWAUKEE, WIS.

KEEP ON TOP OF THE HEAP

"Men are growing up who have had greater advantages than the older ones of us, and they are going to succeed where their forebears failed.

"They are not going to be satisfied with the results of a few years ago.

"They are going out after the last penny and they are going to get it through the use of highly trained men and UP-TO-THE-MINUTE EQUIPMENT. You cannot afford to bother with anything but the best." Thus Mr. T. Warren Allen, Chief of the Division of Control, Bureau of Public Roads, recently addressed contractors.

To remain at the head of your field you must keep yourself informed regarding all new equipment. With this fact in mind PUBLIC WORKS conveniently lists the newest equipment catalogs each month under the heading of INDUSTRIAL LITERATURE on the yellow sheets in the back of the book.

Fill out the handy coupon on page 55, so we can send you a new set of catalogs today.

PUBLIC WORKS

243 West 39th Street
New York

Reg. U.S. Pat. Off.

It Passes
The
Underwriters'
Tests
100%
and
CENTRAL FLOOR PLATES

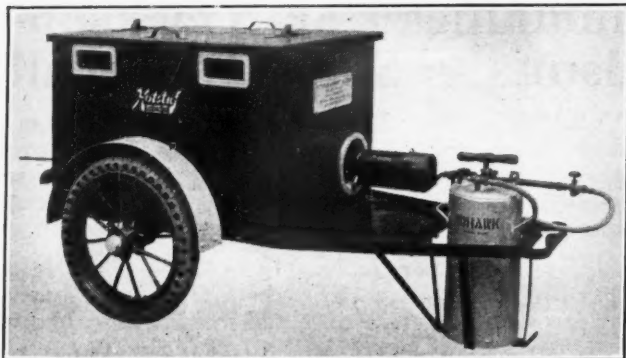
Underwriters'
Laboratories
Inspected
S.A. 443

will pass any test to which you will subject them.

Send for our interesting literature
CENTRAL IRON & STEEL CO.
HARRISBURG, PA.

Continental Bldg., Baltimore, Md.
131 State Street, Boston, Mass.
110-116 Washington St., New York, N. Y.
Stock Exchange Bldg., Philadelphia, Pa.
301 Seitz Bldg., Syracuse, N. Y.

Another Hotstuf Heater Advancement



Exclusive Elevated Melting Chamber, Produces Hotstuf
30 Per Cent. Faster with 30 Per Cent. Less Oil
This saving alone will soon pay for the equipment. "Let us prove it."

A High SPEED Trailer as well as a High SPEED Melter
DESIGNED TO MEET THE TIMES

Mounted on an EXTRA HEAVY Axle with Special length
ROLLER BEARINGS.

Equipped with Firestone Demountable CUSHION TIRES,
especially compounded to withstand high temperatures and
protected by heavy constructed heat guards.

These New Features make it now possible to trail at high
SPEED without danger of damaging the heater, adding con-
siderably to the life of the equipment, and SAVING time and
labor in transportation.

A contractor's **MOST PROFITABLE** investment

Write us for prices and further data

Mohawk Asphalt Heater Co.

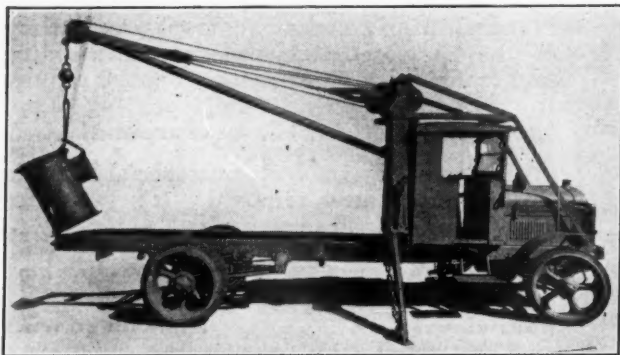
Schenectady, N. Y.

Main Office and Factory
56 Weaver St.

Branch Office and Warehouse
2445 W. 21st Place, Chicago, Ill.

New York Office, Room 705, 12 East 41st St.

AUTO TRUCK DERRICK



HOISTS—LOADS—DIGS

CONVERT your truck into a TIME and LABOR saver with this
derrick. It will serve many purposes if mounted on a chassis of
sufficient tonnage.

With **HOOK** or **CHAINS**, it lifts pipes, girders and other solid objects.
With **LAZY TONGS** it handles barrels, bales, boxes, crates, etc. With
CLAM SHELL or **ORANGE PEEL** bucket it loads stone, gravel, sand,
coal and other soft or loose material.

ONE OPERATOR standing on truck has absolute control over the load
and its placement.

The construction of this derrick is such that it can be knocked down,
packed compactly and shipped anywhere. Derrick has large factor of
safety over specified capacity. Protection from breakage due to over-
load is insured by patented slipping clutch set to lift slightly in excess
of rated capacity.

Operation of clam or orange peel bucket is simple, any unskilled work-
man can operate this machine and it will also do the work of vertical
hoists on trucks for raising and lowering body.

Prices and fuller details will be sent on request. Certain territory
still available for first class Distributors. Correspondence invited.

ATIA CORPORATION

150 BROADWAY,

NEW YORK, U. S. A.

Also ATIA Ash and Garbage Removal Bodies

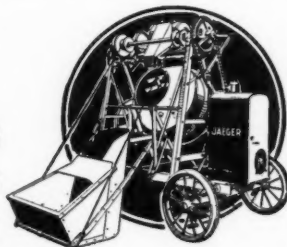
Jaeger
TILTERS

AUTOMATIC POWER LOADERS

All sizes—3½, 5, 7, 10, 14 ft.
Capacity. 36 Labor Savings
Models and Attachments.

Get our popular prices on heavy
duty Trailer Mixer with springs
and cushion tires.

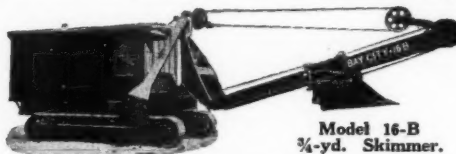
Jaeger now furnishes **NON-
TILT MIXERS** in all sizes up
to 1 yd. capacity—also **PLAS-
TER MIXERS**.



A faster, light, one-bag
Mixer with **TIMKEN**
Roller Bearings.

THE JAEGER MACHINE COMPANY
400 DUBLIN AVE. COLUMBUS, OHIO

Convertible Power Shovels

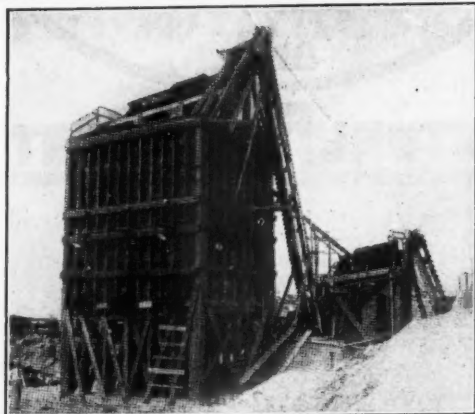


Model 16-B
¾-yd. Skimmer.

Contractors are finishing jobs in record time and at
a lower than usual cost with these machines—the
heavy convertible Skimmer-Ditcher and the convert-
ible Tractor Shovel. Write for literature.

BAY CITY

BAY CITY DREDGE WORKS, Bay City, Mich.



DEPENDABLE SERVICE

Any Equipment Will Undoubtedly Give Satisfactory
Results for a Short Time, but—

RELIANCE UNITS

**CAN BE DEPENDED UPON FOR
CONTINUOUS, UNFAILING SERVICE**

Our products have established an enviable record of performance
under the most exacting conditions. The First Reliance Crusher,
built in 1903, is Still in Active Operation at Calvary Cemetery,
Brooklyn, N. Y.

WE OFFER A COMPLETE LINE OF
Road Building, Maintenance, Quarry and Gravel
Handling and Washing Equipment

With your permission we shall be glad to
mail you catalogue and prices.

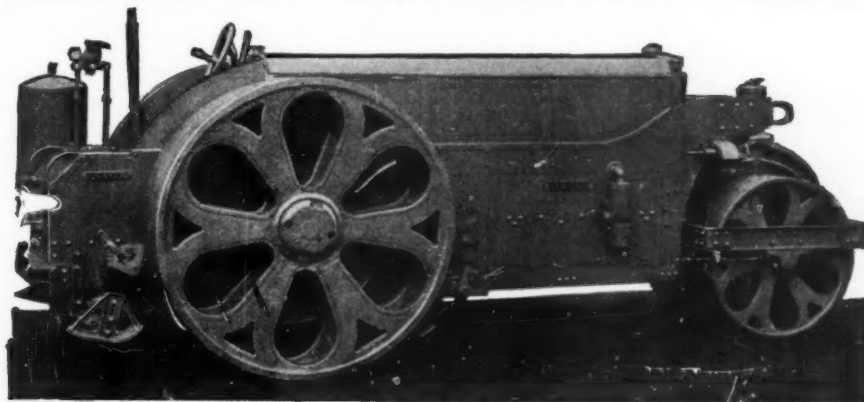
UNIVERSAL ROAD MACHINERY CO.
KINGSTON, NEW YORK

HUBER

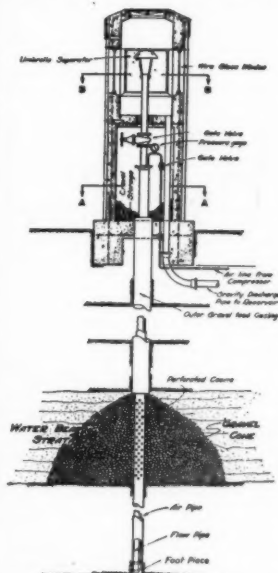
MOTOR ROLLERS

Four cylinders—four sizes (5, 7, 10, and 12 tons). Look to Huber for easy single-lever control—short turns—quick action—low upkeep—unusual dependability. The Huber is endorsed and used by leading contractors everywhere. It will be worth your while to send for free catalog, giving full mechanical details.

THE HUBER MFG. CO. 325 Center Street MARION, OHIO



Cheap Water for Greensburg, Kansas



Detail of Air Made Well

Air Made Wells and Sullivan Air Lift solved a difficult water shortage situation at Greensburg, Kansas; and at the same time gave the city water at a lower cost per thousand gallons, than it had secured with other pumping systems.

Four drilled wells had gone dry, and a huge dug well 32 feet in diameter, and 96 feet deep had fallen off to 90 gallons per minute, when Air Made Wells and Sullivan Air Lift were installed. A single 8-inch Air Made test well, pumped with Sullivan Air Lift, produced at the start, 70 gallons per minute. Within four weeks it was furnishing 150 gallons per minute, and this well will now supply 225 gallons per minute, if desired.

Greensburg's own figures show that Sullivan Air Lift is delivering water to the city mains at a cost of less than 3c per thousand gallons including power, attendance, and depreciation.

Write for the 48-page Air Lift Handbook, 3371-1.

Sullivan Machinery Company

138 S. Michigan Avenue, Chicago

S U L L I V A N

When Snow Flies—

remove it
quickly
cheaply
completely



An H. P. "One-Man" Grader

will keep miles of highway free from snow—at minimum cost.

Moves quickly—turns readily—steers easily and is simple, durable, economical and dependable.

Have an H. P. on hand, ready to clear roads after the first snow fall. Write us today for complete information.

W. A. RIDDELL COMPANY

Bucyrus, Ohio

Successors to The Hadfield-Penfield Steel Co.

KOEHRING

Look Over the Koehring 14-S!

HERE'S a big producer of Koehring re-mixed concrete!

Look at the charging skip — takes the full batch, and no need for shoveling aggregate back into skip! It's high speed hoisting and clean charging! Fast discharge—like all the Koehrings!

Narrow frame — handy for tight places — and amazingly short turning!

Radiator cooled!

Worm Drive Transmission on roller bearings through flexible clutch! All moving parts in oil bath. Koehring freight car truck type of drum roller bearings, bronze bushed and enclosed in cast housing!

Drum end control — operator sees everything, has every lever in arm's reach. He's away from engine fumes!

Know the Koehring — know the 14-S.

Write for Construction Mixer Catalog No. CM. 14

SIZES

Pavers — 7-E, 13-E, 27-E. Auxiliary equipment and choice of power to suit individual needs. Complies with A. G. C. Standards.

Construction Mixers — 10-S, 14-S, 21-S, 28-S. Steam, gasoline or electric power. Mounted on trucks or skids. Rubber tired wheels optional. 28-S on skids only. Complies with A. G. C. Standards.

Dandle Mixer — 5-S, 7-S — 5-S single cylinder, 7-S two or four cylinder gasoline engine. Power charging skip, or low charging hopper and platform. Rubber tired steel disc wheels or steel rimmed wheels. Complies with A. G. C. Standards.

KOEHRING COMPANY

PAVERS, MIXERS — GASOLINE SHOVELS, CRANES AND DRAGLINES
MILWAUKEE, WISCONSIN

Sales Offices and Service Warehouses in all principal cities

Foreign Department—Room 1370, 50 Church St., New York City, A4097-I
Mexico, F. S. Lapum, Cinco De Mayo 21, Mexico, D. F.





"The Engineer was Particular—"

and here's what the Contractor had to say about him:

"—Our superintendent tells us that after the McWane pipe is laid and properly caulked that he had no trouble in making tests.

"The Engineer was particular in testing. He would get down in the trench and examine each Precalked joint, and usually took a dry rag and passed it entirely around the joint, and if it showed the least moisture the joint would be recaulked. Fortunately for us, he found very few joints that showed moisture."

Sizes 1 1/4 thru 8 inches. Standard lengths.
Precalked Fittings.

"We pioneered—and lead—in production of very small cast iron pipe."

We like a "fussy" engineer. He does good work himself, demands it in others, and appreciates it in McWane pipe.

He may be hard to convince at first that a lighter pipe can be stronger, a factory-made lead joint better than a trench-made one—

But when he does see it, he's a life convert to "3 times the speed for 1/2 the labor" (McWane Precalked Joint Pipe).



McWane Cast Iron Pipe Company
BIRMINGHAM, ALA.

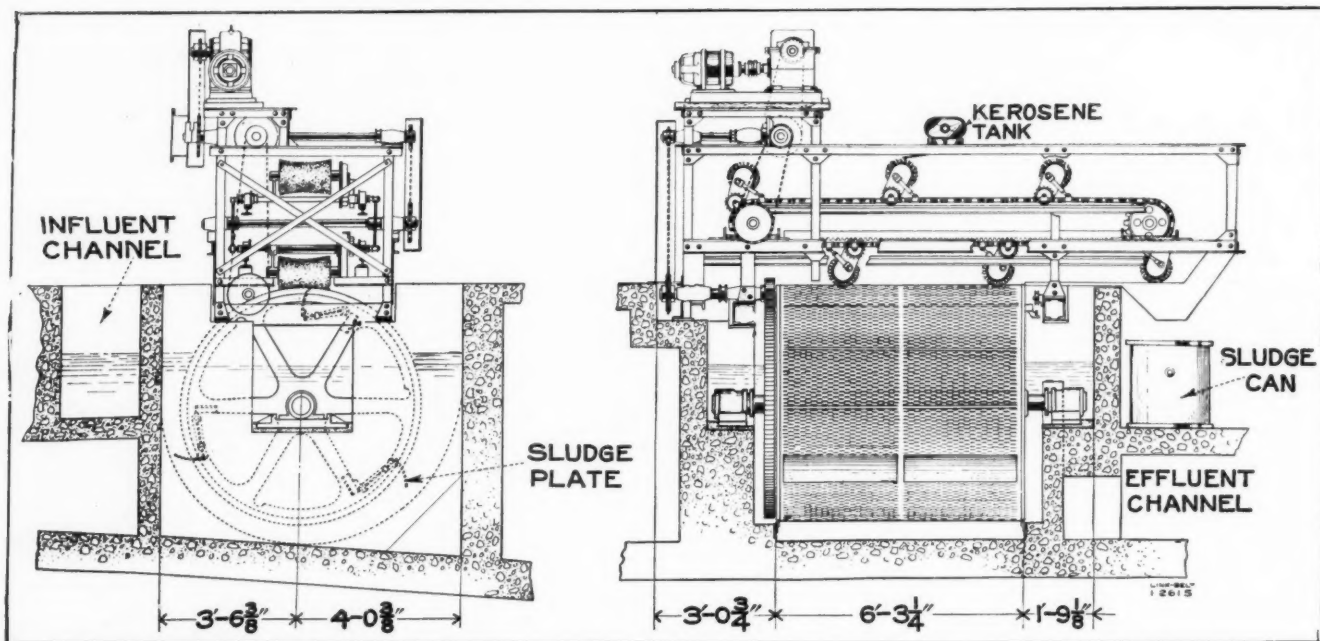
819 Bankers Trust Bldg., Philadelphia, Pa.
208 S. La Salle St., Chicago, Ill.
1807 Santa Fe Bldg., Dallas

Pacific States Cast Iron Pipe Company
PROVO, UTAH

608 Subway Terminal, Los Angeles 611 Spalding Bldg., Portland
149 West 2nd South, Salt Lake City

McWane factory made joint
CAST IRON PIPE

Efficiency In the Removal of Suspended Solids



6 ft. Diameter Tark Sewage Screen for the Borough of Keansburg, N. J. Alexander Potter, Consulting Engineer.

EFFICIENCY in the removal of suspended solids by a screen is especially important where the effluent is chlorinated. In such a case, efficiency means a saving in dollars and cents to the municipality every day in the year.

The State Board of Health of New Jersey requires a guarantee of the removal of 10% of the suspended solids by every screen, where screening is the sole treatment.

The Department of Health made tests during July, 1926, of the Tark Screen installed by the Borough of Keansburg, N. J.

Keansburg, being a seaside resort, the week-end population is about three times

as great as the ordinary; therefore, both midweek and week-end tests were run on the removal of the suspended solids.

Screenings were collected for one hour, drained for one hour, and then weighed. The amount of the drained material removed per million gallons of sewage was as follows:

	P. P. M. Suspended Solids	Screening per. M. G.
Midweek July 13-14	259	2573 lbs.
Week-end July 17-18	262	3043 lbs.

These figures indicate the efficiency of Tark Screens. With this known efficiency are combined reliability and economy of operation. May we send you complete data? Write our nearest office.

LINK-BELT COMPANY

Leading Manufacturers of Elevating, Conveying, and Power Transmission Machinery and Chains

CHICAGO, 300 W. Pershing Road

Atlanta, - - - 511 Haas-Howell Bldg.
Birmingham, Ala. - 720 Brown Marx Bldg.
Boston - - - 1103-4 Stalter Bldg.
Buffalo - - - 554 Ellicott Square

Cleveland - - - 527 Rockefeller Bldg.
Denver - - - 520 Boston Bldg.
Detroit - - - 5933 Linsdale Ave.
Huntington, W. Va. - Robson-Prichard Bldg.

INDIANAPOLIS, 200 S. Belmont Ave.

PHILADELPHIA, 2045 Hunting Park Ave.

Kansas City, Mo., R. 436, 1002 Baltimore Ave.
Louisville, Ky. - - - 397 Starks Bldg.
New Orleans - 504 New Orleans Bank Bldg.
New York - - - 2676 Woolworth Bldg.

Pittsburgh - - - 335 Fifth Ave.
St. Louis - - - 3638 Olive St.
Toronto 2, and Montreal, Link-Belt Limited
Wilkes-Barre - 826 Second Nat'l Bank Bldg.

H. W. CALDWELL & SON CO.:—Chicago, Western Ave., 17th and 18th Sts.; Dallas, Texas, 810 Main St.; New York, 2676 Woolworth Bldg.

LINK-BELT MEESE & GOTTFRIED CO.:—San Francisco, 19th and Harrison Sts.; Los Angeles, 361-369 S. Anderson St.; Seattle, 820 First Ave., S.
Portland, Ore., 67 Front St.; Oakland, Calif., 526 Third St.

LINK-BELT

Sewage Disposal Plant Equipment



THE BOURBON COPPER AND BRASS WORKS

MANUFACTURERS OF

FIRE HYDRANTS, STOP VALVES AND EXTENSION VALVE BOXES

WATER WORKS AND FIRE DEPARTMENT SUPPLIES
THE BOURBON OPEN AND SHUT INDICATOR POST

Nos. 618 and 620 E. Front St.

CINCINNATI, O.

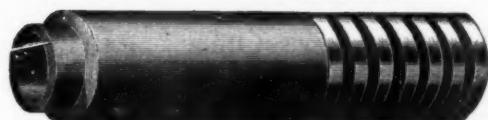
ASPHALT PLANTS

PORTABLE,
STATIONARY, RAILROAD,
SAND DRYERS

Either Direct Heat or Internal Flame

The
J. D. FARASEY MFG. CO.
CLEVELAND, OHIO

STANDARD WOOD PIPE



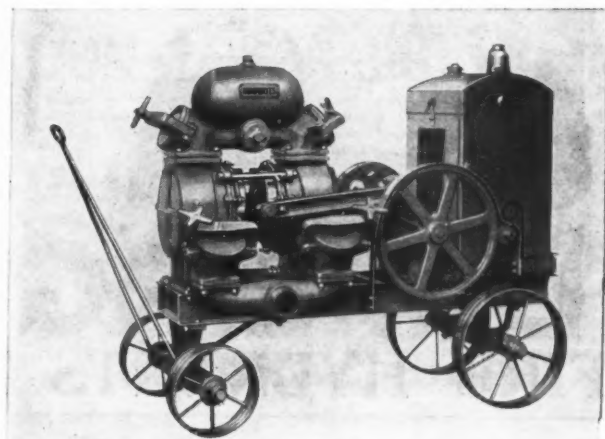
MORE DURABLE AND ECONOMICAL

Will furnish pipe to suit conditions.

Write for catalogue for full information.

STANDARD WOOD PIPE COMPANY

WILLIAMSPORT, PA.



INVESTIGATE THIS PUMP

Here's the pump you need. Designed for all general drainage work it has many features that will appeal to you.

Sturdy, compact and accessible this pump marks the latest improvement in dewatering equipment.

Write for Bulletin 290-P.

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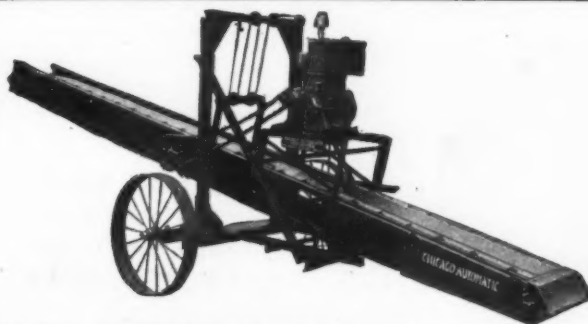
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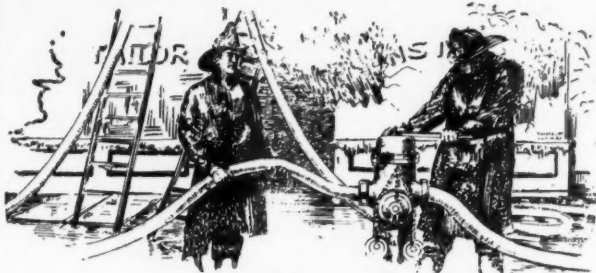
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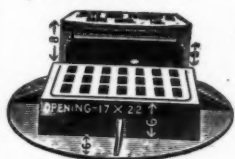
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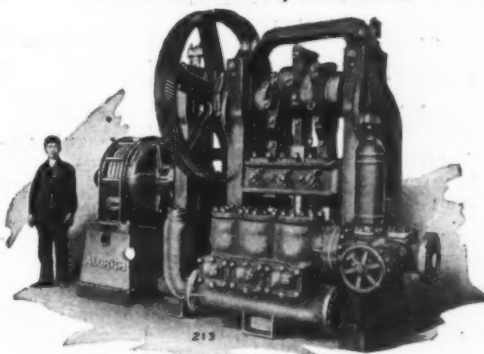
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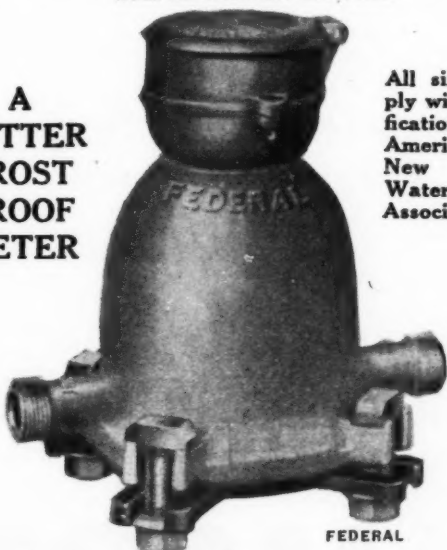
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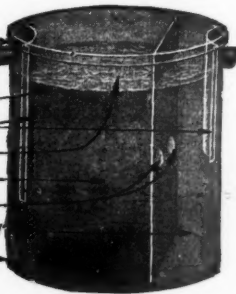
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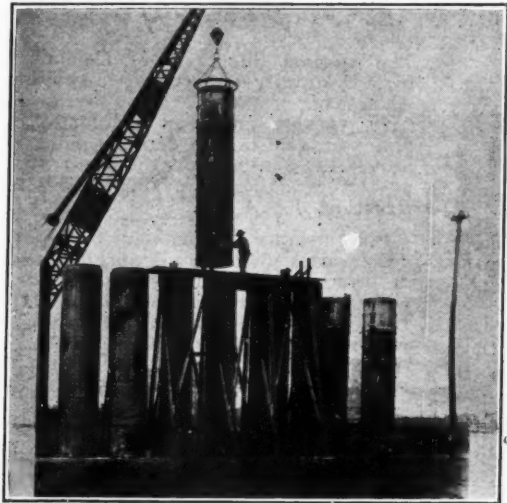
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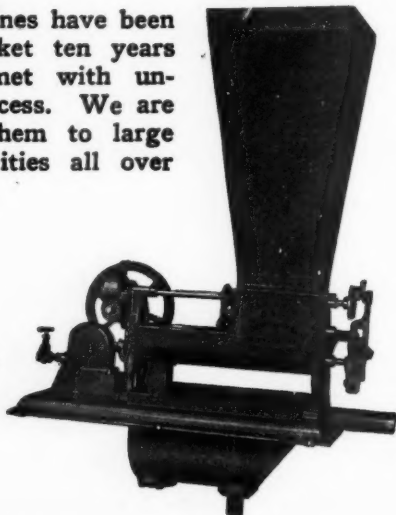
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INDEX TO ADVERTISEMENTS

A Aldrich Pump Co. 49 Alvord, Burdick & Howson 50 American Steam Pump Co. 43 American Steel & Wire Co. 22 Ansonia Hotel 48 Armco Culvert Mfrs. Assn. 43 Atia Corporation 34 Austin-Western Rd. Mach. Co. ... 2	F Farasey, J. D., Mfg. Co. 47 Federal Meter Corp. 51 Firestone Tire & Rubber Co. 25 Flanders Hotel 45 G Galion Iron Works & Mfg. Co. .. 32 Gamon Meter Co. 51 Golden Anderson Valve Specialty Co. 49 Goulds Pumps, Inc. 52	N Nat'l Cast Iron Pipe Co. 62 Newark Conc. Pipe Co. 52 Niles Machine Co. 14 Novo Engine Co. 61
B Barber-Greene Co. 31 Barrett Co., The .....Back Cover Bay City Dredge Works 34 Belvedere Hotel 28 Black & Veatch 50 Bourbon Copper & Brass Wks. Co. 47 Brossman, Chas. 50 Buffalo Meter Co. 23 Buffalo-Springfield Roller Co. 16 Builders' Iron Foundry 49 Burns & McDonnell Eng. Co. 50	H Hansen, A. E. 50 Hazen & Whipple 50 Headley Good Roads Co. 16 Heflin, J. Otis 48 Heltzel Steel Form & Iron Co. 17 Hersey Mfg. Co. 5 Hill, Nicholas S., Jr. 50 Honhorst, Jos., Co. 30 Huber Mfg. Co. 35 Humphryes Mfg. Co. 47	P Pacific Flush-Tank Co. 21 Pearse, Greeley & Hanson 50 Penn. Salt Mfg. Co. 24 Pittsburgh-Des Moines Steel Co. .. 26 Pollard, Jos. G., Co., Inc. 21 Pollock, Clarence D. 50 Potter, Alexander 50 Progressive Clay Co. 48
C Caird, James M. 50 Carter, Ralph B., Co. 23 Caterpillar Tractor Co. 59 Celite Products Co. ....Front Cover Cement Lined Pipe Co. 45 Central Foundry Co. 63 Central Iron & Steel Co. 33 Charleroi Iron Works 26 Chemical Toilet Corp. 52 Chicago Automatic Conveyor Co. . 47 Cleveland, H. Burdett 50 Cleveland Tractor Co. 27 Coldwell-Wilcox Co. 49 Columbian Iron Works 51 Connery & Co., Inc. 61	I Insley Mfg. Co. 15 J Jaeger Machine Co. 34 Johnson, C. S., Co. 12	R Riddell, W. A. Co. 35 Russell Grader Mfg. Co. 18
D Darling Valve & Mfg. Co. 48 Dee, Wm. E., Co. 43 Donaldson Iron Co. 49 Dorr Co. 7 Dow Chemical Co. 28 Dow & Smith 50 Du Pont De Nemours Co., E. A. ... 10-11	K Kennedy Valve Mfg. Co. 24 Keystone Driller Co. 51 Kinney Mfg. Co. 29 Kinney Standards, Inc. 30 Koehring Co. 36	S Savage Co., W. J., Inc. 52 Schramm, Inc. 14 Servicised Products Corp. 3 Smith, A. P. Mfg. Co., The 45 South Bend Foundry Co. 49 Standard Oil of Indiana 57 Standard Wood Pipe Co. 47 Sterling Eng. Co. 62 Stewart, W. H. 23 Sullivan Machinery Co. 35 Sweet's Steel Company. 30
E Edson Mfg. Corp. 45 Electro Bleaching Gas Co. 51	L Leadite Co., Inc. 54 Link-Belt Co. 478b Littleford Bros. 28 Lock Point Pipe Co. 9 Lufkin Rule Co. 32 M Mackenzie's, Duncan, Sons Co. 30 Mack Trucks, Inc. 29 Martinique Hotel 18 McWane Cast Iron Pipe Co. 478a Mohawk Asphalt Heater Co. ... 34	T Thew Shovel Co. 19-20 Trackson Co. 33 U U. S. Cast Iron Pipe & Fdy. Co. .. 13 Universal Crane Co. 32 Universal Road Mach. Co. 34 W Walker Cement Prod. Co. 21 Wallace & Tiernan Co. 4 Warren Bros. 6 Williamsport Wire Rope Co. 8 Wolfe, G. Morton 50 Wood, R. D., & Co. 22 Wood Hydraulic Hoist & Body Co. 12

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CONTRACTORS' EQUIPMENT

Air Compressors

1. Air Compressors, portable Motor Driven, Stationary, Portable Belt Driven, Portable Tractor Combination are fully described and illustrated in a 32-page and cover catalog issued by Schramm, Inc., West Chester, Pa.

2. Sullivan Machinery Co., Chicago, has a new catalog describing portable air compressors, including WK-312, two cylinder gas engine driven; WK-314, four cylinder gas engine driven; WK-34, Fordson belt driven; WK-32, electric motor driven—Bulletin 77-N, 16 pages, 6x9.

6. Ingersoll-Rand Portable Compressors are built in the sizes as gasoline engine or electric motor driven units. There are various styles of mountings or furnished without running gear. Ingersoll-Rand Co., 11 Broadway, New York. Bulletin 3415.

Asphalt Plants

10. J. D. Farasey Mfg. Company, Cleveland, Ohio, issue folders of specifications for Farasey Portable Asphalt Paving Plants. These R. R. 1-car plants have easy capacity of 2,250 yards, 2" surface per 8 hours.

Admixtures for Concrete

15. Data on the use of Celite as an admixture in concrete for improving workability, uniformity and water-tightness are contained in Bulletin 325 of the Celite Products Company, 11 Broadway, New York City.

16. Specification clauses for architects and engineers covering diatomaceous silica for its use as an admixture as well as directions for the use of Celite are given in Bulletin 317 of the Celite Products Company, 11 Broadway, New York City.

Chip Spreader

17. A folder describing Reliance Chip Spreader, a special trailer with dump body and hoist. Spreads any thickness desired. Does better work than can be done by hand and cuts cost. Universal Road Machinery Co., Kingston, N. Y.

Concrete Accelerators

20. "How to Cure Concrete," a forty-seven-page manual published by the Dow Chemical Company, Midland, Michigan, treats fully the subject suggested by its title. A well-illustrated and instructive volume.

Concrete Mixers

25. Koehring Company, Milwaukee, Wisconsin, have a new illustrated and descriptive catalog on the 7-S Dandie Mixer. Every detail and feature of construction is shown with complete description.

27. Concrete Mixers manufactured by the Jaeger Machine Company, Columbus, O., described in booklet. 32 pages, 6x9.

28. Koehring Company, Milwaukee, Wisconsin. Catalog showing complete line of paving mixers manufactured in sizes of 7E, 13E and 27E.

29. Koehring Company, Milwaukee, Wisconsin. Illustrated 48-page catalog on construction mixers giving complete specifications of 10S, 14S, 21S and 28S sizes.

No. 31. Koehring Company, Milwaukee, Wisconsin. Have new illustrated folder on the 5S Dandie; also descriptive card on 10S Dandie.

Chutes and Towers, Concrete

40. The Insley Manufacturing Company, of Indianapolis, describes concrete chutes in connection with steel towers and Mast Hoist Plants in Catalogs 44 and 45. 95 pages and 16 pages, 8x11.

41. The Insley Manufacturing Company of Indianapolis describes steel towers and steel masts in connection with chutes for placing concrete, in Catalogs 44 and 45. 95 pages and 16 pages, 8x11.

Dredges

45. The Bay City Dredge Works, Bay City, Mich., issue Catalog D, describing Bay City Land Dredges for canal and open ditch excavation or cleanout and ditch maintenance work. Oil engine operated. 72 pages, 6½x10.

Drills.

47. "Jackhammer" Rock Drills are operated by compressed air or steam and all excepting the smallest type can be equipped for wet drilling. There are six sizes. Ingersoll-Rand Company. Bulletin 4146.

50. Sullivan Machinery Company, Chicago, builds its Rotator Type hand-held hammer drills in seven models for many rock drilling purposes. One is a steam engine. Bulletin 81-F, 32 pages, 6x9.

Drills, Tunneling, Water, Jet

55. Sullivan Machinery Company, Chicago, has a new catalog, No. 81-E, describing its DW-64 water jet tunnelling drill, 135 lb. weight. May be used on tripod or bar for down holes to 32 ft., or as 90 lb. hand drill with suitable handles. 16 pages, 6x9.

Dump Bodies, Steel

60. Ford Truck Steel Dump Bodies and hydraulic hoists are manufactured by the Wood Hydraulic Hoist & Body Company, 4196 Bellevue Ave., Detroit, Mich.

62. "Hoists, Dump Truck." Double the Truck's Value by using power operated Hydraulic Hoists. Catalog of WOOD Hydraulic Hoist and Body Company, Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

63. "Dump, Bodies, Steel." WOOD Hydraulic Hoist & Body Co., Detroit, Mich., manufacturers all Steel Dump Bodies for every hauling proposition and Self-Dumper Bodies for road builders Trucks. Special Bulletins.

Dust Laying or Curing Concrete Products

65. The Carbondale Calcium Company, Carbondale, Penna., have for distribution, a booklet entitled "Curing Concrete with Calcium Chloride," also a booklet entitled "Excuse My Dust," which will be mailed upon receipt of any applications from the trade.

Hoists

67. "Novo Hoisting Handbook." Gives detailed descriptions of hoisting jobs of every type in every part of the country. Completely illustrated with pictures and diagrams. Novo Engine Co., Lansing, Michigan.

Hoppers, Measuring

70. The C. S. Johnson Co., Champaign, Ill., publish a folder which describes the Johnson Demountable Bins and Measuring Hoppers. Sent on request.

Loaders and Unloaders

74. The Chicago Automatic Conveyor Co., Old Colony Bldg., Chicago, Ill., issue literature describing Portable Conveyors with Non-Clogging Receiving ends. Sent on request.

75. The Universal Road Machinery Company, Kingston, N. Y., issues two bulletins describing the Reliance Portable Car Unloader and Reliance Chip and Sand Spreader.

80. Link-Belt Company, Philadelphia, the originators of Portable Loaders, have issued a folder giving recently reduced prices on the famous "CUB" Loader (belt type), and the Type "C" bucket loader, with condensed information on other popular types.

81. An interesting book describing Link-Belt Rivetless Chain, replete with illustrations, supported by tables of weights and strengths, the advantageous uses on conveyors, elevators, etc. Address the Link-Belt Co., Chicago, Philadelphia or Indianapolis.

82. Car Loaders. The Heltzel Bulletin No. 8 describes car unloaders and other contractors' equipment. The Heltzel Steel Form & Iron Co., Warren, Ohio.

Motor Trucks and Tractors

91. The Huber Mfg. Co., Marion, Ohio, issues bulletins, "Huber Tractors" and "The Huber Scarifier." Illustrations of machines in operation and testimonials from users.

92. "Kerosene Power, the Low-Price Road Builder," bulletin by the International Harvester Co., Chicago, shows economy of kerosene tractors. Illustrations, specifications and figures on cost of operation.

93. "There Is a Definite Reason for Every Road Building Success," issued by International Motor Company, 25 Broadway, New York, tells how three big operations were handled and reasons for success.

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94. "Earth Moving and Hauling of Building and Road Materials," 32-page illustrated booklet showing part of motor trucks in highway building and bulk hauling. International Motor Company, 25 Broadway, New York.

96. "To Meet Emergencies and Insure Profits," a booklet issued by the Trackson Company, 503 Clinton St., Milwaukee, Wis., for contractors, points out the dependability and economy of the Fordson equipped with Trackson Full-Crawlers.

97. "Trucks for Federal, State, County and City Governments," issued by Graham Brothers, the truck division of Dodge Brothers, Inc., gives information about company's trucks in municipal, county, state and government activity.

Pumps, Contractors'

100. The Edson Manufacturing Corporation, Boston, describes its improved designs in diaphragm pumps, both hand and power; odorless force pumps, and suction hose for the same and other pump accessories. 9 pages, 8½x11.

102. Bulletin No. 56, illustrating the Barton Portable Pump and its attachment to automobile motors, describing the simplicity of operation and its many practical uses, issued by the American Steam Pump Co., Battle Creek, Mich.

104. In a 160-page catalog Aldrich Pump Co., Allentown, Pa., describes and illustrates Road, Deep Well and other pumps for every service. When interested in pumps write for this catalog.

105. Humding'er Diaphragm force pumps open discharge diaphragm pumps, triplex road pumps and portable centrifugal pumps described and illustrated in bulletin No. 102. Ralph B. Carter Co., 152 Chambers Street, New York City.

107. Lift and Force Trench Pumps in three and four inch sizes, trailer units and electrically driven sludge pumps are illustrated in bulletin 290 of The Humphries Manufacturing Company, Mansfield, Ohio.

Road Finishing Machines

110. The Heltzel Steel Form & Iron Co., Warren, Ohio, publish a treatise of finishers, strikeoffs and graders, including descriptions of hand finishers, automatic strikeoff and grader.

Road Rollers, Scrapers, Graders, etc.

112. Everything for the Road Maker. Good Roads Machinery Co., Kennett Square, Pa., issue a 48-page catalogue describing complete line of Road Graders, Rock Crushers, Road Drags, Road Rollers, Oiling Machinery and Culvert Pipe.

113. The Buffalo Springfield Roller Company, Springfield, Ohio. Pocket size booklet with return card, showing all types of Buffalo Springfield steam and motor rollers and scarifiers. 20 pages, 6¼x3½.

114. "The Austin Western Line." A sixty-four-page catalog has been issued by the Austin-Western Road Machinery Company describing their full line of road building machinery. Included in it are illustrations and descriptions of road graders, 5-foot blade to 12-foot blade; road rollers, steam or gasoline powered, 3 to 15-tons single cylinder to four cylinder. Motor graders, three sizes. Elevating graders, three sizes. Scarifiers. Crushing plant equipment, small road tools, etc.

Special bulletins on each separate piece of machinery supplement the general catalog.

115. Kinney Road Rollers, 2 to 6 tons driven by Fordson and with rear hitch are described, illustrated and priced in a folder. The rollers are rugged, easy to handle, rolls path 61 in. Before buying a roller write for complete description. Kinney Standards, Inc., 191 Clifton Place, Brooklyn, N. Y.

116. Acme Road Machinery Co., Frankfort, N. Y., issues descriptive bulletins of gas and steam rollers, rock crushers, graders and other road building machinery.

120. Rock Crushers, Elevators, Conveyors, Screens and Bins. The Good Roads Machinery Co., Kennett Square, Pa., issue a 36-page illustrated book describing Champion Rock Crushers, attachments for same and portable and stationary rock crushing plants.

122. The Galion Iron Works and Manufacturing Company of Galion, Ohio. New illustrated bulletins on their Master Four Cylinder Motor Roller, Four Cylinder Tandem Roller, International Motor Roller and International Motor graders.

123. The Russell Grader Mfg. Co., Minneapolis, issues an illustrated catalog of its road equipment, horse and tractor graders, motorized graders, drags, scrapers, gravel equipment, etc., Printed in three colors, 64 pages, 8½ x 11.

Sand and Gravel Washing Plants

130. Link-Belt Co., Chicago, issues a seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy.

Steam Shovels, Cranes, Excavators

139. Speeder Machinery Corp., Cedar Rapids, Iowa, in their bulletin J26, describe Speeder Shovels, Cranes and Draglines. Copy sent on request.

140. The Bay City Dredge Works, Bay City, Mich., issue Catalogs 24 and 25, printed in two colors describing one-man operated, convertible gasoline or electric caterpillar mounted shovels for trench excavation and general material handling work.

148. The Insley Mfg. Co., Indianapolis, Ind., issues special booklets on portable gas unit excavators, concrete construction and contractors' equipment.

149. Koehring Company, Milwaukee, Wisconsin, Catalogs giving complete specifications, working dimensions and illustrations on the Koehring No. 301 and 501 gasoline or electric shovels, cranes and draglines.

Steam Shovels, Cranes, Excavators

152. "Ditching Snapshots & Records," booklet by the Barber-Greene Company, Aurora, Ill., describes fully the work of the new Barber-Greene Trencher.

155. Crawler and Locomotive Cranes, with Grab Bucket, Hook Block, Pile Driver, Scrap Bucket, Steam Shovel Dipper, etc., are described in catalogs of 28 and 40 pages, issued by Link-Belt Co., Chicago.

Steam Shovels, Cranes, Excavators

156. Gasoline or electric locomotive crane, suitable for mounting on crawler, heavy duty trailer, industrial truck, railroad flatcar, portal pier or motor truck (readily transferable from one to another) are featured in Bulletin No. 136-Y offered by the Universal Crane Company, 914 Swetland Bldg., Cleveland, Ohio.

Truck Cranes

157. Truck Cranes of 5, 6 and 7½ ton lifting capacity full revolving, gasoline or electric powered, for mounting on 5 ton or heavier motor trucks, equipped with clamshell, dragline, pull shovel, backfiller, etc., are described in a 28-page Bulletin No. 136-X offered by the Universal Crane Company, 914 Swetland Bldg., Cleveland, Ohio.

Steel Forms

160. The Heltzel Steel Form & Iron Company, Warren, Ohio, issue a series of booklets describing Heltzel Curb and Gutter Forms, Steel Road Forms and Sidewalk Forms.

161. Road Forms. The Heltzel Bulletin No. 8 describes steel road forms and other contractors' equipment.

162. Curb and Gutter Forms. The Heltzel Bulletin No. 8 describes curb-and-gutter forms, straight curb and integral curb and base forms.

163. Sidewalk Forms. The Heltzel Bulletin No. 8 describes steel sidewalk forms and other contractors' equipment.

STONE CRUSHERS SCREENING PLANTS

165. "Reliance Road Building and Quarry Equipment." A 36-page catalog describes portable and stationary crushers—built in 7 sizes. Portable and stationary screening plants with or without bins. Stationary plants. Universal Road Machinery Co., Kingston, New York.

Trenching Machines

166. "Ditching Snapshots & Records," booklet by the Barber-Greene Company, Aurora, Ill., describes fully the work of the new Barber-Greene Trencher.

GARBAGE DISPOSAL

175. The Sterling Garbage Destructor, a booklet recently published by the C. O. Bartlett & Snow Company, Cleveland, Ohio, describes the operation of the Sterling furnace and a typical installation, and illustrates plants in leading cities.

176. "United States Standard Incinerator" built and guaranteed by the Pittsburgh-Des Moines Steel Company, 679 Professional Building, Pittsburgh, Pa., is described fully in a Booklet.

PAVING MATERIALS

219. "Advantages of Roadbed Subdrainage." Roadbed kept dry, continuous drainage, no interruption from any cause, ample strength. A 16-page illustrated pamphlet, issued by Armco Culvert Mfrs. Association, Middletown, Ohio.

Warrentite Bitulithic

220. All about Warrentite Bitulithic pavement for all road conditions described in 15 booklets of words and pictures. Scenic views and technical descriptions of famous highways. Warren Bros. Company, Boston, Mass.

Concrete Curing Compound

230. The Dow Chemical Company, Midland, Mich. "How to Cure Concrete" is a "manual" of instruction on the curing of concrete pavements." A handy, useful volume, well illustrated. 47 pages, 5½x7½.

231. The Dow Chemical Company, Midland, Mich. "How to Maintain Roads" is a manual of information on road building and maintenance. Contains tables of composition, grading, etc.

245. The Serviced Products Corp., 6051 W. 65th St., Chicago, Ill., issue literature describing their "Servicised Cellular Expansion Joint." Sent on request.

Rail Filler

251. The Serviced Products Corp., 6051 W. 65th St., Chicago, Ill., issue literature describing Servicised Rail Filler. Sent on request.

260. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with "Tarvia K-P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

261. "Road Maintenance with Tarvia." Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. 56 pages, illustrated, 6x9. The Barrett Company, New York.

262. "Tarvia." An attractively illustrated booklet describing grades of Tarvia and showing photographs of actual applications. 32 pages, 9x6. The Barrett Company, 40 Rector Street, New York City.

USE THE COUPON AT BOTTOM OF THE FIRST PAGE IN THIS SECTION



W Ferry Street, La Crosse, Wis. *W*

Asphalt Penetration Macadam constructed
in 1917 with

Stanolind Paving Asphalt

This road is in excellent condition after
ten years of service

*Asphalts for Every
Purpose*

STANDARD OIL COMPANY

(INDIANA)

General Offices: 910 South Michigan Ave.

CHICAGO, ILLINOIS

263. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. Profusely illustrated with photographs. 24 pages, 6x9. The Barrett Company, 40 Rector Street, New York.

Preservatives

270. Preservation of Streets and Roads by the Use of Road Oil, with many illustrations and testimonials from users. The Standard Oil Co., of Indiana, Chicago.

271. Stanolind Paving Asphalt, a compound prepared by the Standard Oil Co. of Ind., is described in minute detail in booklet "Stanolind." Standard Oil Co. of Indiana, Chicago.

ROAD AND STREET MAINTENANCE EQUIPMENT

272. "Increasing Efficiency of Roadbed Drainage." A discussion of a new method of sub-drainage and its advantages and application to highway and municipal work. Sixteen pages fully illustrated, issued by Armco Culvert Mfrs. Association, Middletown, Ohio.

Dust Control

273. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance. It contains tables of composition, grading, etc.

276. The Mohawk Asphalt Heater Company, Schenectady, N. Y., presents a New Bulletin describing the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater, for general construction and maintenance. 4 pages, 6 1/2 x 10.

277. Connery & Company, Inc., of Philadelphia, has issued a new catalog describing improving types of Tar and Asphalt Heating Kettles for the road contractor. 30 pages, 6 1/2 x 8 1/2.

278. Connery & Company, Inc., of Philadelphia, has issued Bulletin No. P-1 describing Oil Burning Patrol Patching Heater for Paving Contractors, Street and Highway Departments.

279. A new catalogue of tar and asphalt heaters, sand and gravel dryers, paving tools, etc., for road and street work, has just been issued by Littleford Bros., of Cincinnati, Ohio. 32 pages, 6x9.

280. Littleford Bros., of Cincinnati, Ohio, issue a new illustrated book showing the application of the Andresen Road Repair Outfit in maintenance of Roads and Streets. 32 pages, 8 1/2 x 11.

Motor Patrols

283. The Russell Grader Mfg. Co., Minneapolis, build four sizes of Motor Patrols—Cietrac 20-K, Caterpillar 2-ton, McCormick-Deering 10-20 and Fordon tractors used for power. Special catalog.

Road Building and Maintenance

284. Illustrated booklet describing use of Trackson Full-Crawlers for grading, ditching, and all road building and maintenance work, sent by Full-Crawler Co., 500 Clinton St., Milwaukee, Wis., on request.

Loaders

285. "Loading Layouts," a booklet—illustrates loading and unloading jobs being carried on with B. G. Loaders and Conveyors. Some jobs are shown with the Loader alone, some with Conveyor alone, and some with the two combined. Published by Barber-Greene Company, Aurora, Ill.

Road and Street Maintenance Equipment

290. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control. It contains tables of composition, grading, etc.

Snow Removers

295. "Snow Insurance," a booklet by the Barber Greene Company, Aurora, Illinois, tells and shows by illustrations how many cities clear their streets with Barber Greene Snow Loaders.

296. The W. A. Riddell Co., successors to Hadfield-Penfield Steel Co., Bucyrus, Ohio, has just issued new circulars describing Fordson Snow Removers and Hadfield-Penfield One-Man Graders.

297. "Open Roads at Low Cost," a new snow removal circular issued by the Trackson Company, 503 Clinton Street, Milwaukee, Wis., describes how hundreds of communities have solved their snow plowing problems with the Fordson equipped with Trackson Full-Crawlers.

Unloaders

301. "Loading Layouts," a booklet—illustrates loading and unloading jobs being carried on with B. G. Loaders and Conveyors. Some jobs are shown with the Loader alone, some with Conveyor alone, and some with the two combined. Published by Barber-Greene Company, Aurora, Ill.

SEWAGE DISPOSAL APPARATUS

304. The Barber-Greene Company, Aurora, Ill., can furnish information on "Loading Dried Sludge" prepared by Andrew Holmstrom of Worcester, Mass.

305. Dorr Company, 247 Park Avenue, New York, in its Sanitary Engineering bulletin describes the use of its equipment for treating municipal sewage, industrial wastes and water. Photos of numerous operating plants are shown as well as representative flow sheets illustrating the various methods of sewage treatment.

306. Link-Belt Company, Philadelphia, issues a book describing the Tank Sewage Screen for separation of solids from incoming sewage—a construction furnishing maximum fine screening capacity, in a minimum space, at minimum cost.

307. The Pacific Flush Tank Company, of Chicago and New York, publish eight separate catalogs on Sewer and Sewage Disposal Automatic Equipment, including pumps, Imhoff Tanks and Sewer Joint Compounds.

310. Advantages of Liquid Chlorine for disinfection given in booklet issued by the Electro Bleaching Gas Co., 9 East 41st St., New York.

312. Full information on the Venturi Meter which has been used for sewage measurements for many years. Bulletin No. 210. Builders Iron Foundry, Providence, R. I.

313. Chlorine is being extensively used in the disinfection of sewage, not only as a disinfectant but as an aid to other purification processes. Wallace & Tiernan Co., Inc., Newark, N. J., have a bulletin, No. 42, on the chlorination of sewage which will be sent to any address on request.

340. The Progressive Clay Co. offices in New York City, Philadelphia, Pa., and Syracuse, N. Y., furnish full information regarding Vitrified Pipe and other heavy clay products. Illustrated price list on application. Factories in Pennsylvania and Ohio.

Pumps

351. The Kinney Mfg. Company, Boston, sends a folder of bulletins on Rotating Plunger Pumps, Unloading Pumps, also tables of information for water works calculations.

Septic Tanks.

355. San-Equip Septic Tanks for homes, institutions, etc., not reached by sewers, are described and illustrated in data sheets and handbook on sewage treatment issued by Chemical Toilet Corporation, Syracuse, N. Y.

356. Septic Tanks made of Copper-Bearing, Rust-Resisting Iron—all seams extra heavy welded, are described and illustrated in a folder published by the manufacturers, Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

STREET CASTINGS

360. Cast iron sewer blocks, ventilators, manhole covers and inlets, valves, etc., described in pamphlet by the South Bend Foundry Co., South Bend, Ind.

STREET CLEANING AND REFUSE DISPOSAL

Vacuum Sweepers

380. The Butler Vacuum Street Sweeper as used by New York and other large cities is described in an illustrated folder issued by the Butler Manufacturing Company, 1810-16 East 24th Street, Cleveland, Ohio.

Sweepers

385. Catalogue No. 4 issued by the Kinney Mfg. Co., Boston, Mass., gives complete information on the sturdy construction and simplicity of operation of the Kinney-Springfield Motor Sweeper, supplemented by numerous illustrations.

WATER WORKS EQUIPMENT

Water Works Supplies

392. "Catalogue No. 11, issued by Joseph G. Pollard Co., Brooklyn, N. Y., gives complete information on Derricks, Lead Melting Furnaces and other equipment used in the laying of Gas, Water and Sewer Pipe.

393. A 50 page catalog issued by Pittsburgh Des Moines Steel Co., Professional Bldg., Pittsburgh, Pa., on complete water works plants, elevated tanks, stand pipes and filtration plants built by them.

Cement Lined Pipe

395. Steel or Wrought Iron Pipe lined with cement and special lead-lined joints, manufactured by the Cement Lined Pipe Co., of Lynn, Mass.

Hydrants

415. "R. D. Wood & Co., Philadelphia. Handy circular describing and illustrating "Mathews" Fire Hydrants, Gate Valves and other water works appurtenances. 16 pages, 7 1/4 x 10 1/4.

416. Gate Valves, Fire Hydrants, Indicator Ports, Floor Stands, etc., together with tables of calculation for mechanical engineers. Catalog 11, leather-bound, 100 pages, 6x9. Darling Valve & Mfg. Company, Williamsport, Penna.

417. Hydrants, tapping apparatus, gate locks, valves and curb cocks described in a series of bulletins issued by the A. P. Smith Mfg. Company, East Orange, N. J.

419. "Newtype" Hydrants and Water Gates are described in a bulletin issued by the Kennedy Valve Mfg. Co., Elmira, N. Y. Bulletins contains diagrams and complete specifications.

420. Columbian Iron Works, Chattanooga, Tennessee, manufacturers of Fire Hydrants and Gate Valves will be glad to send a folder describing and illustrating their product. They conform strictly to the standard specifications of the American Water Works Assn.

Meters

425. "Watch Dog" Current Meters for every need manufactured by the Gamon Meter Company, 282 South Street, Newark, N. J. Catalog of illustrations, 19 pages, 7x10.

426. The Buffalo Meter Company, Buffalo, issues a very complete catalog describing Niagara and American disc water meters. These meters are made with either solid type casing or frost bottom casing.

427. The Buffalo Meter Company, Buffalo, issues a special catalog describing Niagara Oil and Gasoline Meters, which explains the method of installing and operating these meters.

USE THE COUPON AT BOTTOM OF THE FIRST PAGE IN THIS SECTION

Dirt Cheap

TAKING dirt from
the wrong place and putting
it in the right place is the con-
tractors' business.... It is the
business of the "Caterpillar"
Tractor to do the work *better,*
quicker, cheaper.

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THIRTY . \$3000
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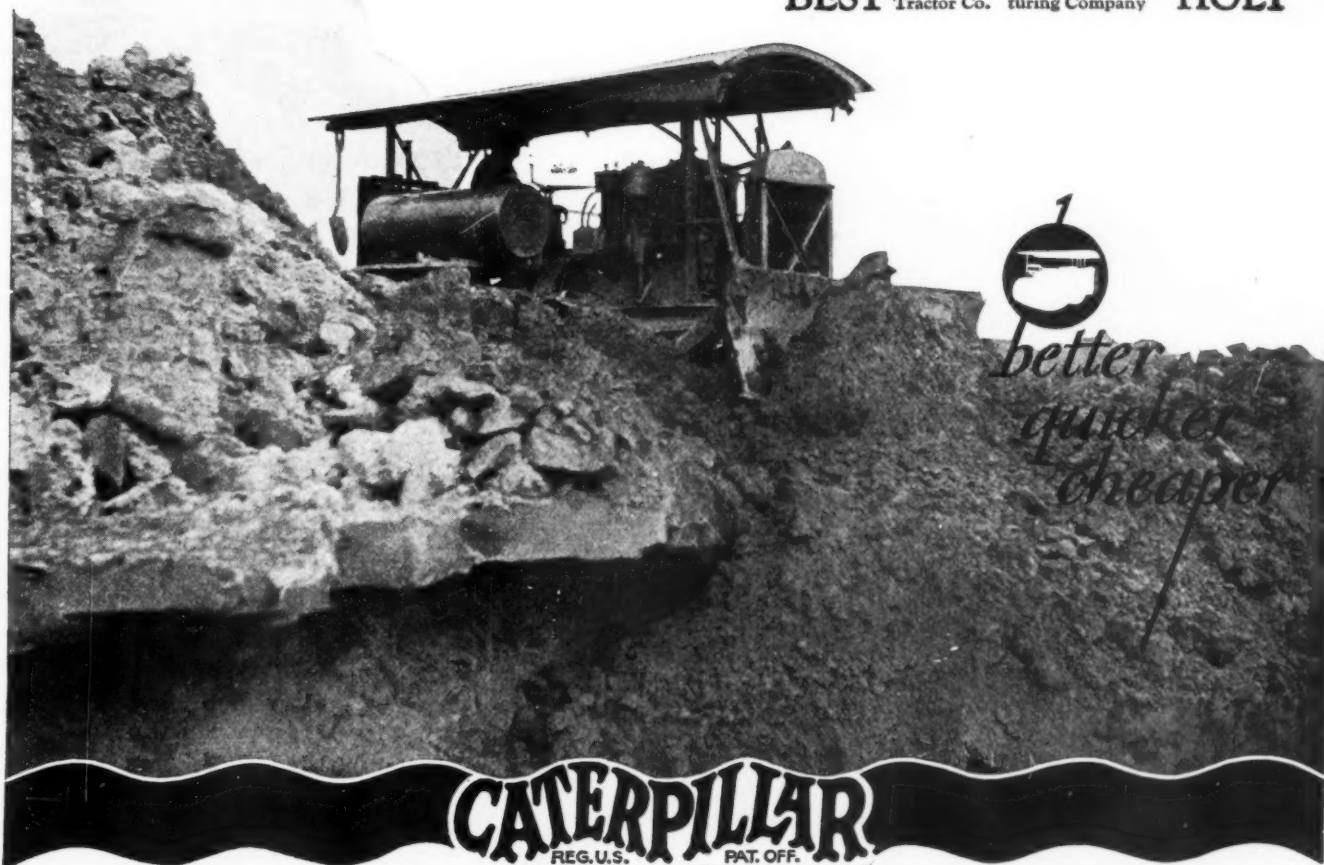
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430. "The Venturi Meter for Main Pipe Lines" contains interesting information and illustrations of many installations of the Venturi Meter manufactured by the Builders Iron Foundry, Providence, R. I.

Meter Boxes—Indicator Posts

432. Meter Boxes, and Indicator Posts, showing whether underground valve is open or shut are described and illustrated in a folder issue by the manufacturers—Columbian Iron Works, Chattanooga, Tennessee.

Pipe, Cast Iron

443. The McWane Cast Iron Pipe Co., Birmingham, Ala., issues Catalog P, describing Cast Iron Pipe, sizes 1 1/4 through 8 inches, equipped with factory-made Precalced lead joints in the bells.

444. R. D. Wood & Co., Philadelphia, issues a new booklet giving weights and dimensions of Cast Iron Pipe and Fittings. A handy reference book for Municipalities and Contractors. 48 pages. 7 1/4x10 1/4.

Pipe Concrete

455. "The Story of Tulsa's Spavinaw Project," "Bringing 'C' Up to 140 Plus," and General Catalogs on Lock Joint Reinforced Concrete Pressure and Sewer Pipes. Lock Joint Pipe Co., 16 Rutledge Ave., Ampere, N. J.

Pipe, Drainage

457. A four-page illustrated folder, issued by Walker Cement Products, Inc., Little Ferry, N. J., describes Rapid Drainage Pipe. It is porous; the entire surface absorbs water. The manufacturers claim that it embodies the most important principle in drain pipe construction that has been developed. If you have any drainage problems write for this folder.

Pumps

460. Pumps of all kinds and for all municipal and industrial purposes illustrated with specifications, also engineering tables of pressure and heads. Bulletins issued by Goulds Pump, Inc., Seneca Falls, N. Y.

467. The Edson Manufacturing Corporation, Boston, describes its improved designs in diaphragm pumps, both hand and power; odorless force pumps, and suction hose for the same and other pump accessories. 9 pages, 8 1/2x11

Pipe Jointing Materials

475. Leadite as an economical composition for pipe joints described in a bulletin by the Leadite Company, Land Title Building, Philadelphia, Pa.

Pumping Engines

480. "When Power Is Down," by the Sterling Engine Company, Buffalo, N. Y., gives illustrations from various cities of Sterling Pumping Engines in use, with recommendations of models for standby services.

Sluice Gates

485. Sluice Gates of all kinds, Roller Bearing Pedestals, Hoisting Standards, Intake Gates, Plug Drain Valves and other Water Works Appliances described in catalog by Coldwell-Wilcox Company, Newburg, N. Y.

Swimming Pools

487. Wallace & Tiernan Co., Inc., Newark, N. J., have just published a new edition of technical publication, No. 41, dealing with the sterilization of swimming pools by liquid chlorine. Copy sent on request.

488. Wallace & Tiernan Co., Inc., Newark, N. J., have just issued technical publication No. 43 on the W. & T. Chloro Boat—a boat

equipped with chlorinating equipment to sterilize bathing areas, small lakes, ponds, etc. Copy sent on request.

Tapping and Valve Machines

490. The A. P. Smith Company, of East Orange, N. J., furnish descriptive matter dealing with their many labor saving devices as the Smith tapping machine, valve inserting machine and pipe cutting machines.

Valves

495. A complete catalogue of more than 210 pages containing descriptions, illustrations, specifications and price list of valves, water-gates and hydrants for every purpose, mailed on request. Kennedy Valve Mfg. Co., Elmira, N. Y.

Water Purification

500. Chlorine and Salts for purification of water and disinfection of sewage with description of Pennsylvania Salt Manufacturing Company's facilities for supplying these cheaply. Booklet, 15 pages, 3 1/2x6. Widener Building, Philadelphia.

501. Wallace & Tiernan Co., Inc., Newark, N. J., have just published a new technical publication, No. 74, describing chlorine control apparatus for the sterilization of the water supplies of small communities. Copy will be sent on request.

MISCELLANEOUS

Blue Printing Machinery and Accessories

506. The Lufkin Rule Company, Saginaw, Mich.; New York; Windsor, Canada. Manufacturers of Measuring Tapes, Boxwood Rules, Spring Joint Rules, Straight and Folding Steel Rules, Fine Mechanics' Tools. General catalog No. 11.

Practical Street Construction

A book devoted to the practical design and construction of streets. This is the only book treating of alignment, grade and cross-section, the location of sewers and other underground constructions, the above ground appurtenances, such as manholes, fire hydrants, fire alarm boxes, street signs, and other features of modern city streets.

242 pages. Cloth\$2.00

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The Designing, Construction and Maintenance of Water-Supply System, both City and Irrigation. Covering every feature of the supplying of water for municipalities. The present edition contains much new matter and embodies the most recent practice and discoveries.

484 pages. Cloth\$4.00

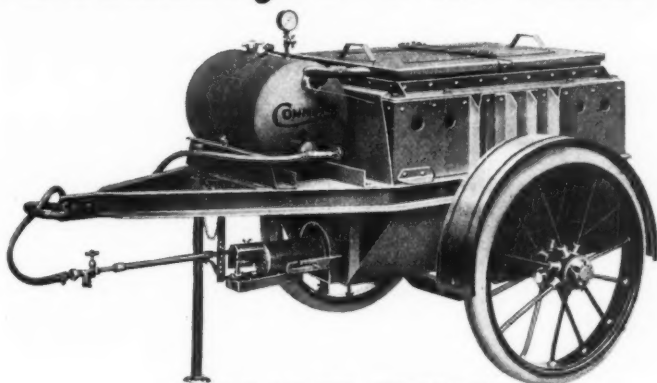
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Made in 50, 75, 100 and 165 Gallons

We are always glad to answer inquiries about tar and asphalt heating problems. We can put you in touch with men who use our heaters if you want first-hand information about them.

The Style "J" Kettle shown is designed exclusively for oil as fuel. Produces hot material in approximately ten minutes after burner is started, and will furnish a continuous supply. Cold material may be added without lowering the temperature of heated material, because the inside tank is so constructed that the hot and cold materials are kept separate. Inside tank electrically-welded and non-leakable. Can be removed for cleaning. Kettle is furnished with roller-bearing wheels and springs, and with or without solid rubber tires.

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The best way for you to find out which Connery Heater fills your needs is to send for our little "Blue Book" and look them all over. With capacities varying from 10 gallons to 1,500, you can see that Connery's Heaters cover the field so far as size is concerned. A glance through this booklet will show you that they cover the field in design and usefulness as well. The "Blue Book" lists and describes all Connery specials in tar and asphalt heaters, sand and gravel dryers, oil burning heaters, pouring pots, etc. You will find the prices low, too.

CONNERY & COMPANY, INC.
3900 N. SECOND STREET PHILADELPHIA, PA.

For Engineers:—

HOME SEWAGE DISPOSAL

By W. A. HARDENBERGH
Associate Editor of Public Works

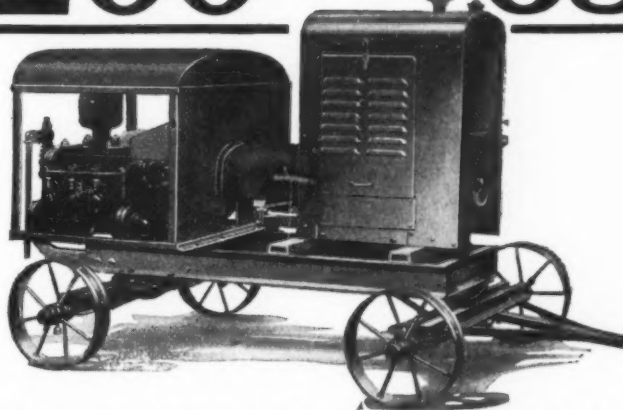
It fulfills a long existing need in supplying reliable facts and information for engineers, city officials and others who are interested in solving sewage disposal problems for single homes, small communities, and institutions. It stands alone as the only engineering book covering thoroughly the problem of sewage disposal of unsewered communities. Chapters on small septic tanks, small Imhoff tanks, secondary treatment, construction, etc.

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This newest and fastest of all "27-E" road pumps—the Novo Flud Oil Triplex. Runs at 200 r.p.m. as against the ordinary 65 r.p.m. It pumps up to 110 g. p. m. under 500 pounds pressure. And it weighs from 500 to 900 pounds less than ordinary pumps of equal capacity. The new Novo Pump Book will show you how to eliminate water hold-ups.

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NOVO THE NEW NOVO FLUD OIL PUMPS
Clarence E. Bement Vice-Pres. & Gen. Mgr.

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"The Sterling Engine we purchased from you a year ago was put to work for the first time and supplied us with water continually for one week until our supply was turned back on from Miami.

"We are very much pleased with them as they never failed to start, or missed a stroke during the run. The water was thirty inches deep in the pump house and the salt water had splashed over the engines, but they started off as if they were perfectly dry."



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Combustion Engines

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STERLING ENGINE CO. Dept. C-5, Buffalo, N. Y., U. S. A.

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The Prado Water Tower of Coral Gables, Fla. A Sterling 6-cylinder engine, 180 H.P. 1200 R.P.M., is direct connected to a Manistee pump.

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PUBLIC WORKS

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ONLY UNIVERSAL PIPE LINES are 100% cast iron. The pipe is cast iron. Its flexible machined iron-to-iron joint—an integral part of the pipe line—is cast iron. Cast iron lasts for centuries.

No hot lead, no cold lead, no lead substitutes. No pouring, no calking. No bell holes to dig. Curves laid with straight lengths. *Every joint as tight as the wall of the pipe itself.* Wrenches the only tools.

[[UNIVERSAL PIPE LINES STAY TIGHT
... because the joint as well
as the pipe is 100% cast iron]]

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PUBLIC WORKS

Join up for '28—

Highway officials who used Barrett materials and service in 1927 will tell you that:

Barrett field men render efficient and unobtrusive assistance in planning and carrying out road building programs.

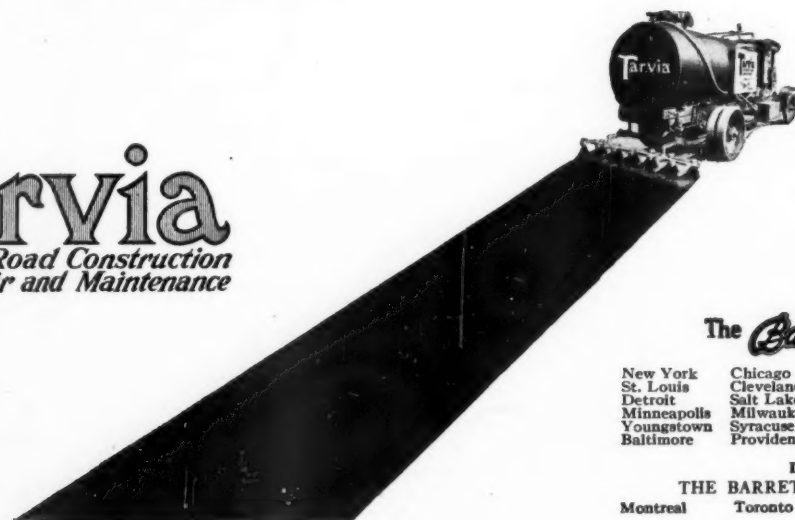
Tarvia deliveries are made by Barrett—where, when and as wanted.

Tarvia is applied from Barrett equipment by specially trained Barrett men—the whole operation supervised by expert Barrett field men.

In brief—The Barrett Company sells more than road building materials—it sells *results*.

We'd like to work with you in '28. Let's talk it over. A post-card will bring the Tarvia field man.

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For Road Construction
Repair and Maintenance



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